APRIL
1960

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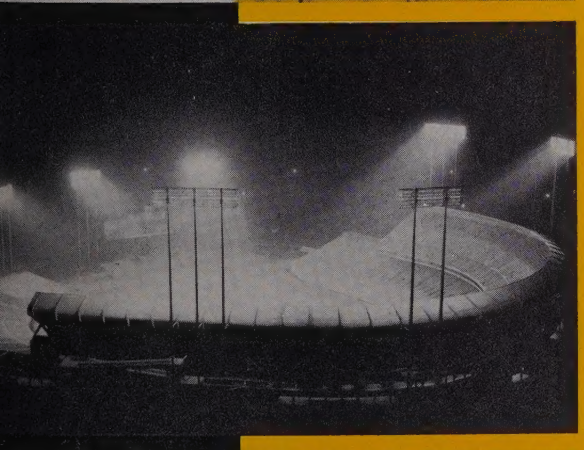
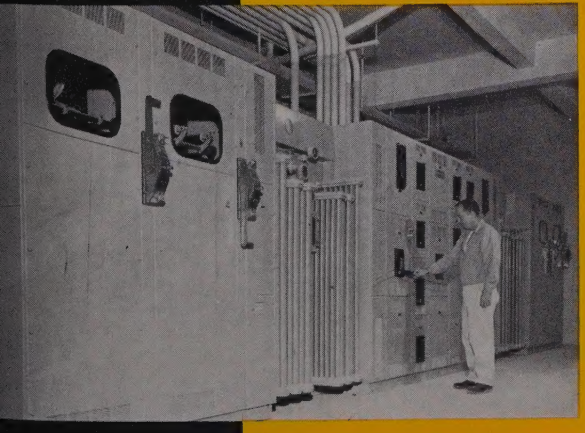
ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

Floor plates on pedestals form accessible wiring chamber and air plenum for data processing center. page 75



Banks of 1500-watt floods, 200 ft above field, light San Francisco Giants' new stadium. page 96



Double ended substation assures service continuity in Johns Hopkins Basic Science Building. page 108

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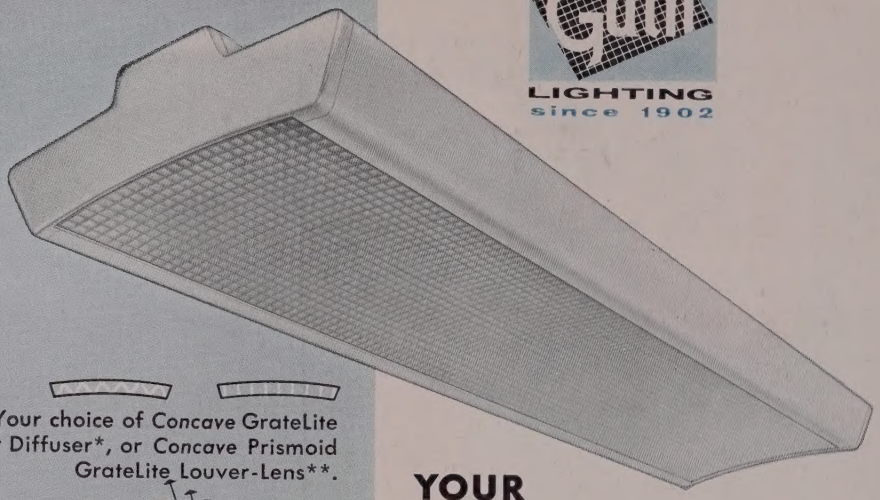
LIGHTING
since 1902



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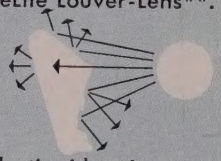
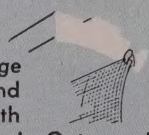
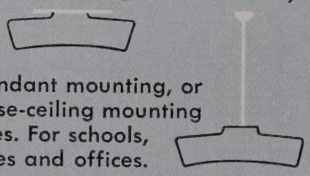


One-piece plastic side wings are tubular for added strength, lower side brightness, plus "reflector" efficiency. Ends are capped to simplify maintenance.



Concave GrateLites *hinge separately* from sturdy steel end plates for extra strength and easier servicing. No glue in Gateway!



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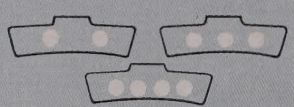

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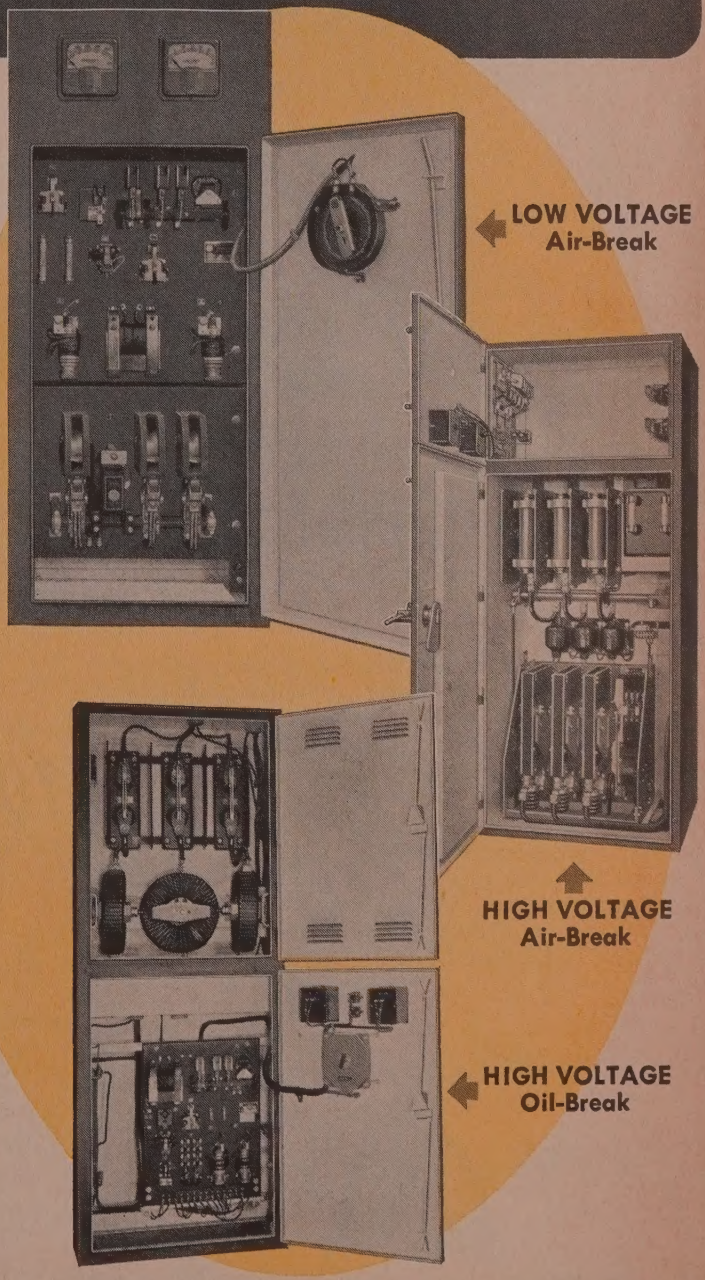

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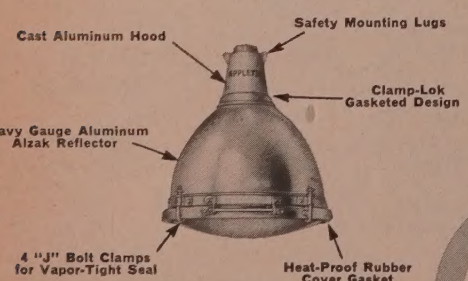

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

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By J. H. WATT—Elaborate electrical systems protect patrons, speed up traffic flow and cut operating costs in public parking ramps.

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"Tailoring" Motor Rewinds 104

By JOHN MOLNAR—A step-by-step outline of the major causes, characteristics and treatments of motor insulation failures—to aid in making rewound motors better than the original which failed.

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

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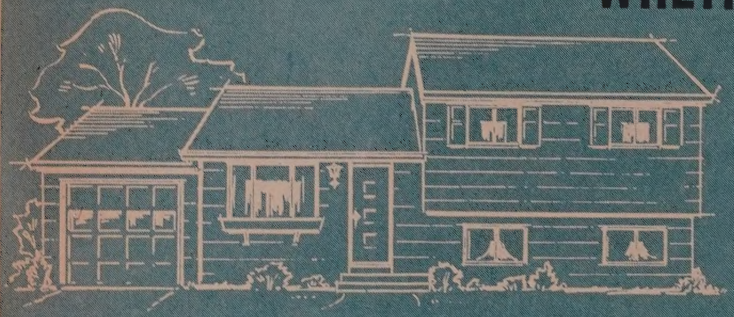

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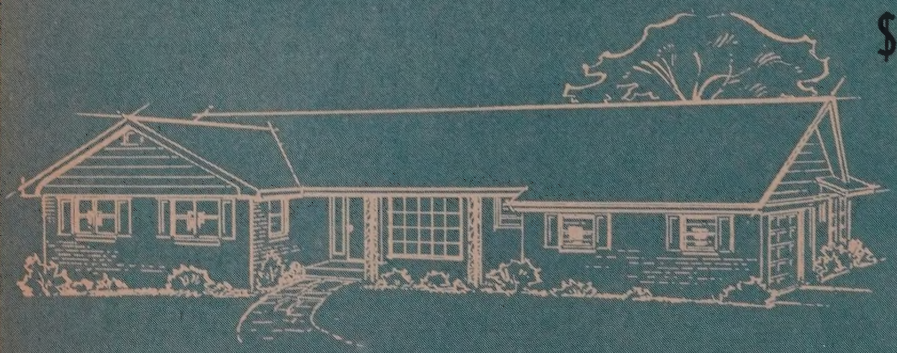

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Sidelights

ELECTRIC HEATING REPRINTS

Our manual of Electric Space Heating which appeared in the March issue has attracted wide attention in the industry. Distribution at the Electrical Heating Symposium in Chicago and mail requests have depleted the available stock of reprints so rapidly that an additional printing may be necessary and consequently there may be a brief delay in filling orders. Because of the basic nature of the project and its importance to the industry at this time, requests for a single copy will be handled without charge. Additional copies up to 100 will be charged at 50 cents each and for 100 or more, 30 cents each. For quantities in excess of 500, ask for special quotation.

DATA CENTER POWER

The special power requirements of electronic data processing machines pose some extraordinary problems in wiring design and layout. Data centers require heavy concentrations of electric power. Frequent changes in equipment lineup and interconnections need extreme flexibility. Power supply reliability is of the utmost importance. And since the load far exceeds maximum heating requirements, the system must provide for year-round air conditioning. One of the largest computer centers in the country recently installed in New York is powered by a system designed by Frank J. Aluisio, chief electrical engineer of Air Research Associates. A specialist in this type of installation, he describes the novel wiring methods employed in "Powering a Data Processing Center," beginning on page 75.

RADIO MAINTENANCE PATROL

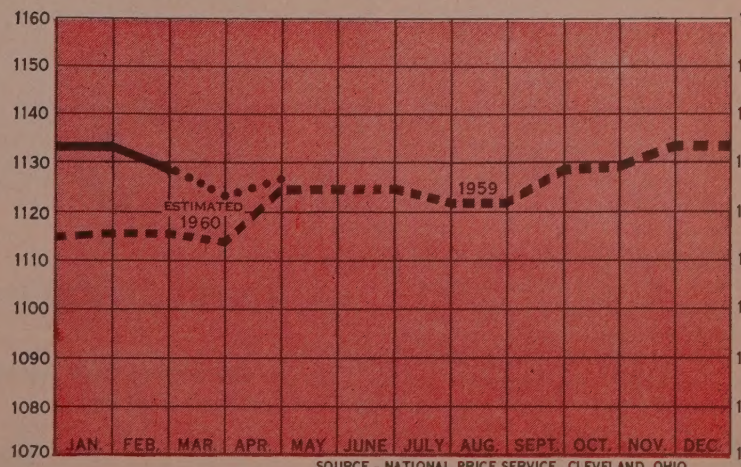
Two-way radio dispatching is used to keep a fleet of mobile electrical maintenance service rigs in constant touch with a central control office in a large industrial plant speeding service and improving efficiency. The system is described in "Radio Patrol for Plant Maintenance," page 81.

NISA CONVENTION

The National Industrial Service Association, the national trade association of electrical apparatus service and repair establishments, will hold its annual convention at the Fontainebleau Hotel in Miami Beach, Fla., May 8-11. A record turnout is expected. Member shops in the Miami area are putting out the welcome mats for the traditional shop tours which are part of the association convention program. For a quick pictorial preview see "Motor Shops in Miami," beginning on page 82.

ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



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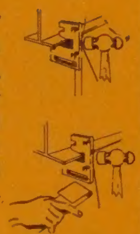
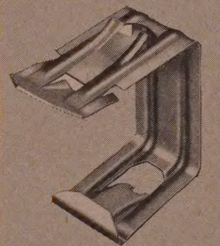
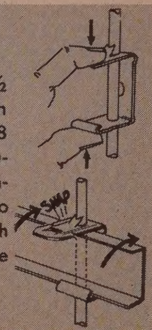


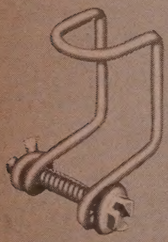
CHANNEL CLAMP



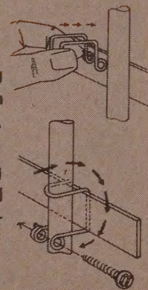
Used for suspending 1½ inch channel from ¼ inch rod, ⅜ inch rod, and #8 wire. Provides instant, accurate alignment prior to channel installation. Designed to accommodate channel with a ½ inch to 9/16 inch flange width. No tools required.



CONDUIT CLAMP

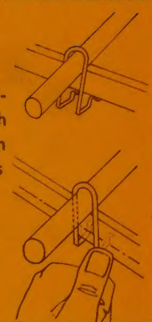


For rigid and positive holding of ⅛ inch, ¾ inch and 1 inch O. D. thin wall conduit. This clamp provides ease of application with secure holding for pattern runs both vertical and horizontal. Screwdriver required.



HOLD-DOWN CLIP

For use as intermediate hold-down of ½ inch, ¾ inch, 1 inch O. D. thin wall conduit between rigid support clamps. No tools required.



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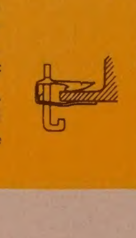
Wire Hold-Down Clip (illustrated) furnished and priced separately.

One size will snap securely in position to beams and columns having ⅛ inch to ⅜ inch thick flanges. The wire hold down element is rotatable to suit any angle of cable or tubing runs, and quickly adjusts to various diameters of cable or tubing. Bridle Rings, Wire Hold-Down Clip and other holding devices are available on request.



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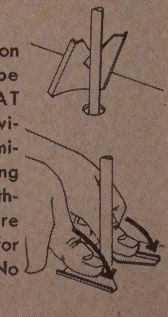
For use on rod to firmly position lighting fixtures, etc. May be backed up with second GAT Fixture Clip (or if rod is previously threaded with nut). Eliminates need for threading rod and is fastest method in finalizing fixture height. Available for ¼ inch rod only. No tools required.



LOWERS "IN PLACE FASTENING COST". The GAT fasteners have completely revolutionized the slow conventional methods of fastening from lathing channel, fluorescent fixtures, conduit, tubing, etc. These ingenious clamps do in seconds what takes minutes with other methods.

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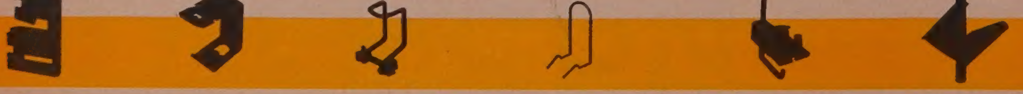

Steel production set an all-time record during the first quarter of this year, of over 34.5 million tons of ingots. This record, however, has been achieved at less than full-capacity production, averaging out at about 94-95%. But a new pattern seems to be emerging, as inventory buying of steel (and hardgoods, including autos) slackens before reaching its old pre-steel strike levels. Forecast for April steel output is at 90% of capacity, and for second quarter at close to 85% of capacity. In spite of this picture, however, steelmakers plan to boost its capital outlays this year by 67% with special emphasis on automation and cost-cutting techniques.

Electricity output has been running ahead of year-ago totals by 7% to 10% according to weekly production figures issued by Edison Electric Institute. Current output is at a rate of 14.0 to 14.27 billion kwhr weekly. All areas of the country have been showing gains, with the greatest gains showing up generally in the Pacific Northwest and the Southeast.

Capital spending is heading for a 14% gain for 1960 over last year, for new plant and equipment, according to Commerce Department's latest estimate. Business now plans to spend $37 billion on capital investment this year, matching the all-time high established in 1957, Commerce reports. This activity is being considered as a major driving force for continued business growth in the months ahead. The estimated $37 billion expenditure this year compares with $32.5 billion total during 1959. Electrical machinery makers, striving to keep abreast of revolutionary developments in electronics, will exceed their previous record by 24%. The same report indicates manufacturers expect 1960 sales to top last year's record by about 8%.

Housing starts dropped to 76,600 units in February, a seasonally-adjusted annual rate of 1,115,000, or 8% below the January seasonally-adjusted annual rate. FHA official Norman Mason attributed drop to last Fall's shortage of mortgage money, and predicted housing starts this year will reach 1.2 million units. But spring home buyers are finding new houses costlier, even as mortgage credit eases. Buyers now pay an average $18,365 for a new house, up from $17,697 last year, and $10,842 in 1950, according to Federal analysts.

New construction dollar value in February was $3.6 billion, Dept. of Commerce reported, a record for the month and only 4% below the January volume. Private spending in February was $2.7 billion, public expenditures totaled $900 million.

Gross national product for the first quarter hit a new record of close to $500 billion annual rate, according to an early estimate of Commerce Dept. economists. The 1959 total GNP was $479.5 billion, and the seasonally-adjusted annual rate for the 4th quarter was $483.5 billion.

Other economic highlights include:

- Industrial production in February was at a seasonally-adjusted index of 167% of the 1947-49 average, one point below January's record 168%.
- Personal income in February was at a seasonally-adjusted annual rate of $393 billion, a record, up from $392.8 billion in January, and up from $371 billion in February a year earlier.
- Employment in February reached 64.5 million, a new record for the month. This was 1.8 million more than were at work a year earlier.

When you want
MORE than just
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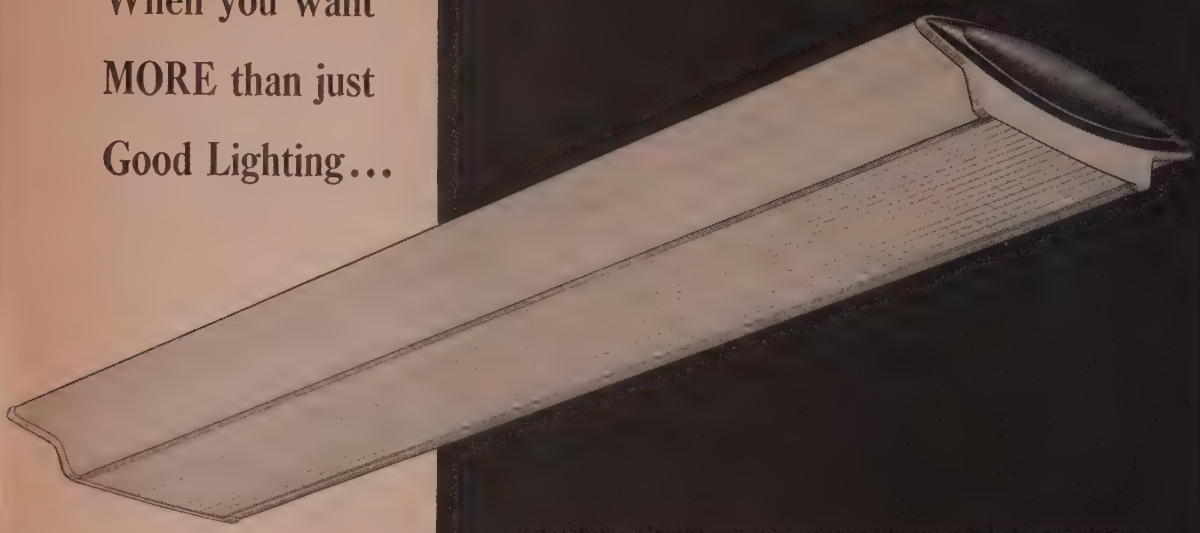

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Series

"Fluorescent lighting fixtures today must do more than provide good illumination. They must also add a distinct element of attractiveness to the ceiling to complement the overall interior décor."

With this concept in mind, Sylvania's Engineering Department, working together with the renowned industrial designing firm of Peter Muller-Munk Associates, created a new fixture family that is truly outstanding.

This is the CLASSIC Series by Sylvania.

The CLASSIC achieves, through its pointed elliptical shape, the elegance and style demanded by today's leading design concepts. This new fixture group features sleek, trim lines, flared, softly-diffusing side panels, and slim shallowness . . . all of which combine to provide a graceful appearance for any interior. To satisfy individual choice, plastic louvers or plastic panels are available.

And the practical aspect has not been ignored either. In addition to its extreme attractiveness, the CLASSIC also provides other important features . . . high-quality lighting characteristics and excellent installation and maintenance advantages.

But a mere description of the CLASSIC is hardly adequate. To appreciate the true beauty and application possibilities of this series you should see the fixture itself.

Write for full information today . . . and ask to have the CLASSIC* demonstrated in your own office.

Sylvania Lighting Products
A Division of SYLVANIA ELECTRIC PRODUCTS INC.
One 48th Street, Wheeling, West Virginia

*Patent Pending

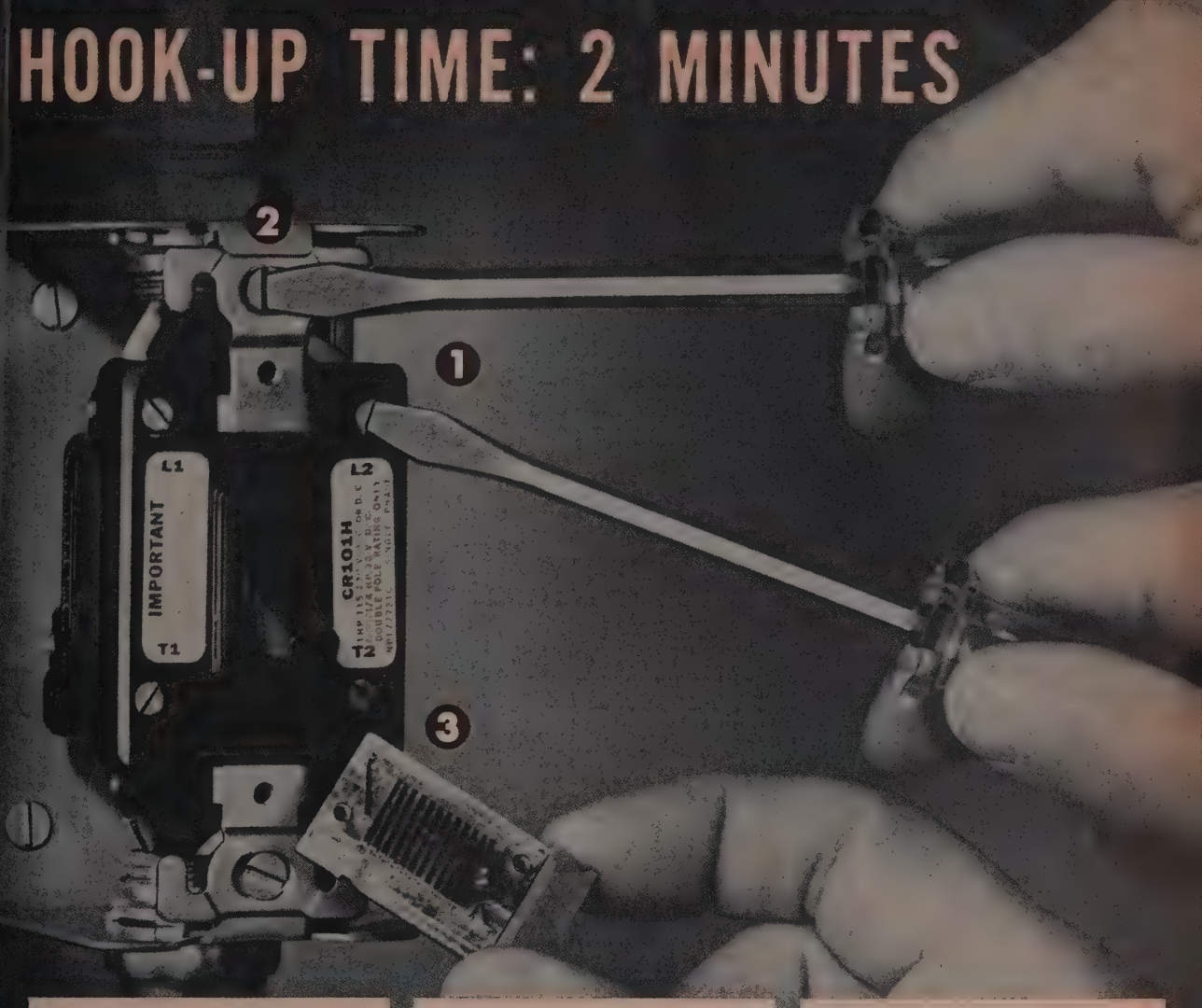
GO MODERN
WITH LIGHTING BY

SYLVANIA GENERAL SYSTEM

Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

FLUORESCENT LIGHTING FIXTURES AND SYSTEMS • BEST FIXTURE VALUE IN EVERY PRICE RANGE

HOOK-UP TIME: 2 MINUTES



❶ Once G-E manual starter enclosure has been mounted on wall or machine, strip wires, insert in pressure-type terminals and tighten terminal screws. No looping necessary. All line terminals are at top, load terminals at bottom.

❷ Position open starter in enclosure and tighten two screws. With wrap-around enclosure cover removed, maximum working room is provided. Compact design of the CR101 manual starter means easier handling, greater wiring space.

❸ Mount heater. Exclusive design plugs in from front in 3 seconds and is keyed to eliminate chance of incorrect insertion. Ampere trip rating is molded on front of heater. Enclosure cover can be replaced by tightening two screws.

KIT PACKAGING of starter components provides 24 combinations. Included are key-operated starters and stainless steel flush plates shown above.

General Electric CR101 Manual Starters Offer Unmatched Installation Convenience and Flexibility

Just 2 minutes to hook up the General Electric CR101 fractional hp manual starter. Multiply this advantage times the number of starters you install every year, and count your dollar savings.

And you can get the exact starter you need from General Electric—any combination of these components: standard or key-operated open starters; single- or two-gang back boxes; standard cover; and wide choice of flush plates—machine grey or stainless steel, for single- or two-gang installations, with or without indicating light. Components are packaged in kits to save more installation time. No disassembly is required before wiring.

Next time you buy manual starters, try the G-E CR101. Ask your nearby G-E distributor for GEA-6358 and GEA-6976 or write General Electric, Schenectady 5, N. Y. 812-01

you get **MEASURABLE ADVANTAGES**
WITH GENERAL ELECTRIC CONTROL

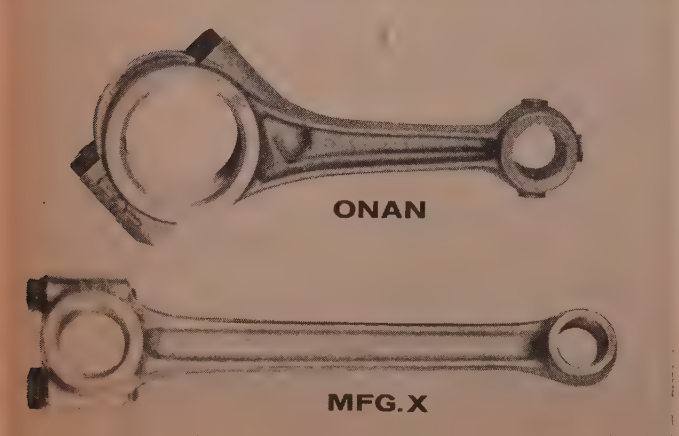
GENERAL ELECTRIC

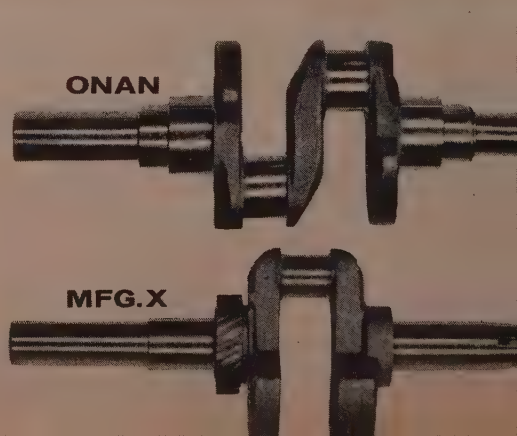
Big, beefy bearings mak
than ordinar

Look at the brawn in this Onan bearing from a 20 HP engine—more than twice the bearing area of most competitive bearings. Look at the built-down-to-a-price bearing from a 20 HP competitive engine. It's about half the size. Which bearing do you think would last longer?

Connecting rods—The shorter stroke of the Onan engine permits the use of a shorter rod, a more rugged design that stands up longer under heavy duty service—another example how Onan builds *up* to performance, not down to a price..

Crankshafts—Larger diameters of main and rod journals make Onan crankshafts stiffer and stronger, minimizing the possibility of breakage or bending. More "muscle" throughout Onan engines means longer life, extra years of full-rated performance.





Onan last years longer electric plants

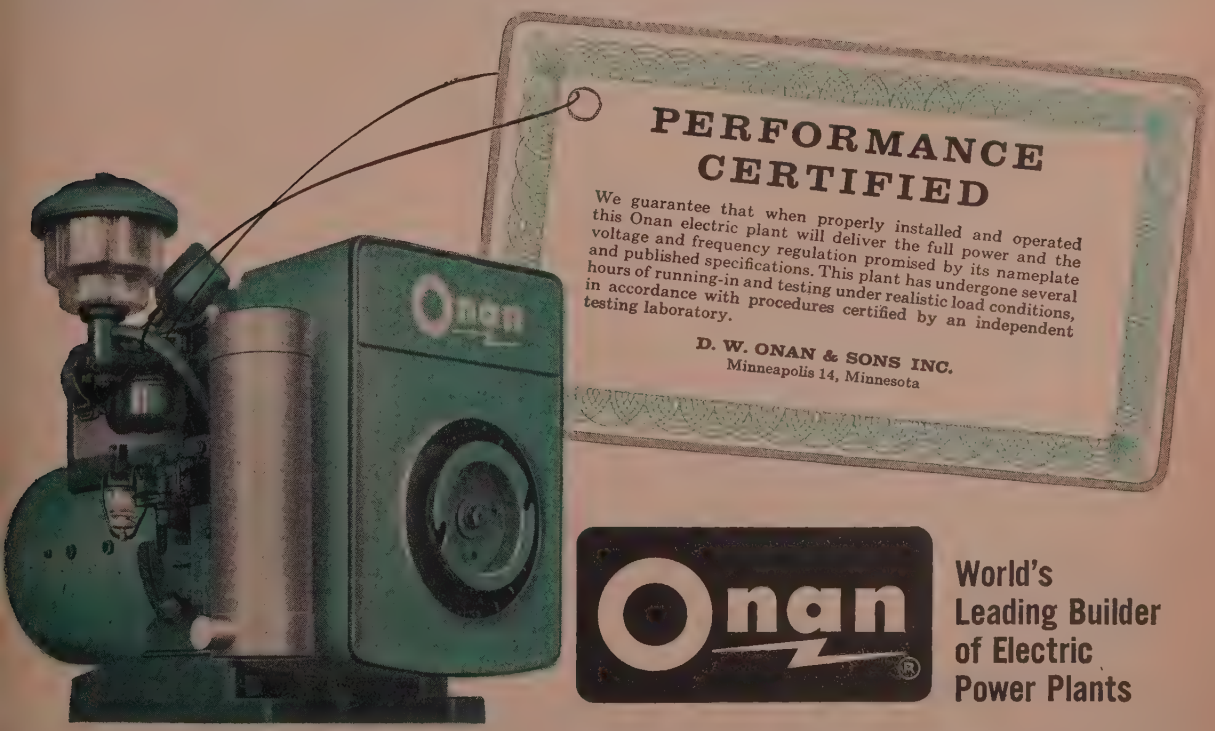
Onan bearings are about twice the size of most competitive bearings

Bearings take a beating in any engine. But, with Onan's bigger bearings the strain is spread over a wider area, giving you longer, more economical engine life.

This is just one example of the extra quality you find in Onan Electric Plants. Each one is checked out at full load for hours before it goes to the shipping dock. Engineers have designed 134 separate tests to make sure it operates the way it is supposed to. Not only that, inspectors from independent laboratories pay surprise visits to the Onan factory, pull units off the line and put them through their paces. It's a double check—on Onan tests and testing methods.

There's an Onan representative near you, ready to tell you about the complete line of Onan Plants, from 500 watts to 230,000 watts. Look for his name in the telephone classified section in all major cities, or write direct.

ONLY ONAN GIVES YOU THIS GUARANTEE



Onan®

World's Leading Builder of Electric Power Plants

D. W. ONAN & SONS INC., 2546 UNIVERSITY AVE. S.E., MINNEAPOLIS 14, MINN.

Minneapolis builder Rodney Billman (right) and telephone man Ken Davies tour one of the former's handsome Wilshire Park homes. Note the conveniently located wall phone in the kitchen.

"Concealed telephone wiring is a big feature to us—a real selling point"

—says Rodney Billman, custom builder of Minneapolis, Minnesota

Since 1948, Rodney Billman, Inc., has built upwards of 400 homes. His current project is Wilshire Park, a distinctive community of custom homes in the $20,000 to $40,000 range four miles from downtown Minneapolis.

These are *telephone-planned* homes—each with multiple built-in outlets.

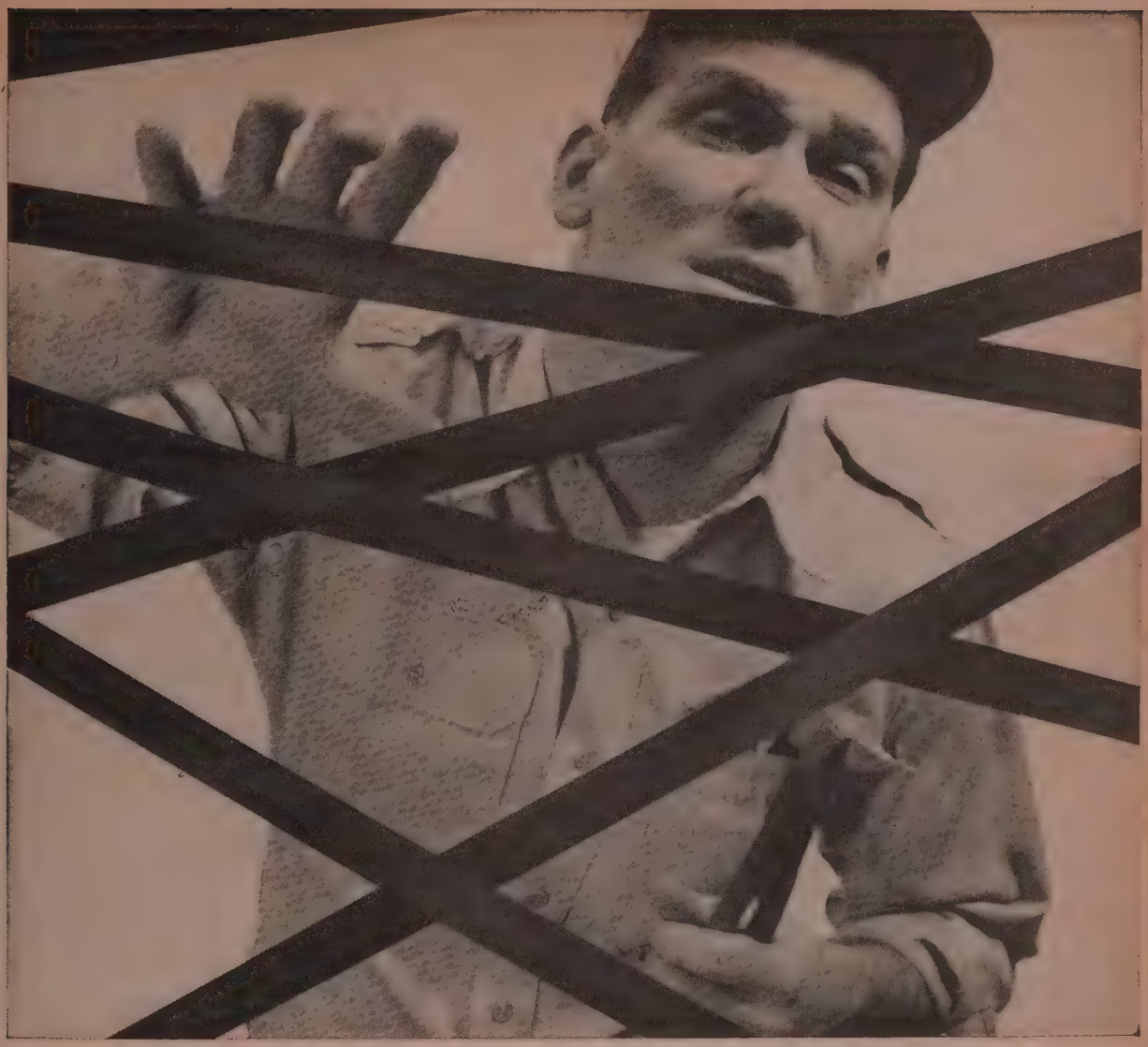
"Telephone planning makes a lot of sense to us," says builder Billman. "We have our own real estate company, and we use the concealed telephone wiring idea as a real sales advantage. It gives the homeowner the flexibility he wants in his telephone service, and protects the interior of his home for him.

"Nowadays, we wouldn't think of building a home without this feature."

* * *

Your local Telephone Business Office will gladly help you telephone plan your homes. For details on home telephone installations, see Sweet's Light Construction File 11c/Be. For commercial installations, Sweet's Architectural File, 34a/Be.

BELL TELEPHONE SYSTEM



Don't Tie Yourself Up In Excess Tape

Save Money with Dutch Brand's new Plastic Electrical Tape in 44-ft. Rolls

Dutch Brand's new 44-ft. roll of Plastic Electrical Tape costs no more per foot than a 66-ft. roll. To you, this means less funds sunk in inventory. It also means you are *not* tied up in excess tape footage that invites waste and pilfering.

Dutch Brand Plastic Electrical Tape is the easy, *better* way to do scores of electrical maintenance jobs. It's thin, strong, flexible . . . provides a dielectric strength of 9,000 volts. Also provides unusual resistance to acids, alkalies, oils, solvents, fungus, bacteria, and gases. Made to highest industry standards. Available in 20'—44'—66' rolls. Order Dutch Brand Plastic Electrical Tape from your supplier today.

WRITE FOR NEW BOOKLET!

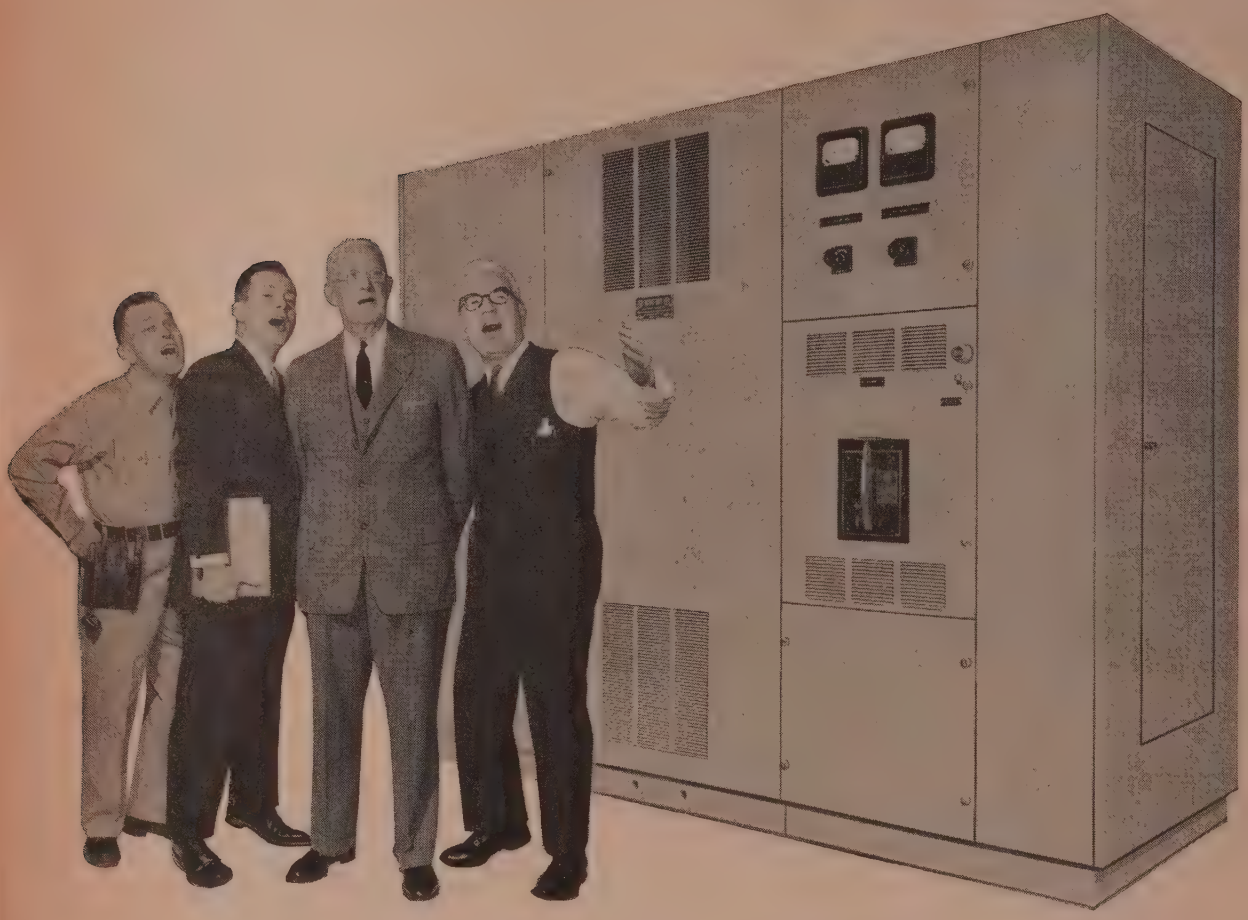
Looking for new ideas on tape as a money-and-time-saver? Ask for "Big Four in Electrical Tapes."

Johns-Manville Dutch Brand Division, 7800 South Woodlawn Avenue Chicago 19, Illinois

JOHNS-MANVILLE JM PRODUCTS

JOHNS-MANVILLE

"WE BOUGHT THE I-T-E TRANFO-UNIT® BECAUSE..."



The TRANFO-UNIT is a complete, self-contained unit substation in a single package. It includes the primary disconnect, transformer, and secondary circuit protective devices.

"So easy to install. There's no complicated assembly at the site. You just position the TRANFO-UNIT and connect."

"Neat, attractive appearance. No hodge-podge arrangement of assorted gear. Saves space too. A real asset for any building."

"Greater safety. Everything is inside the TRANFO-UNIT. No exposed hot parts. It needs no fence."

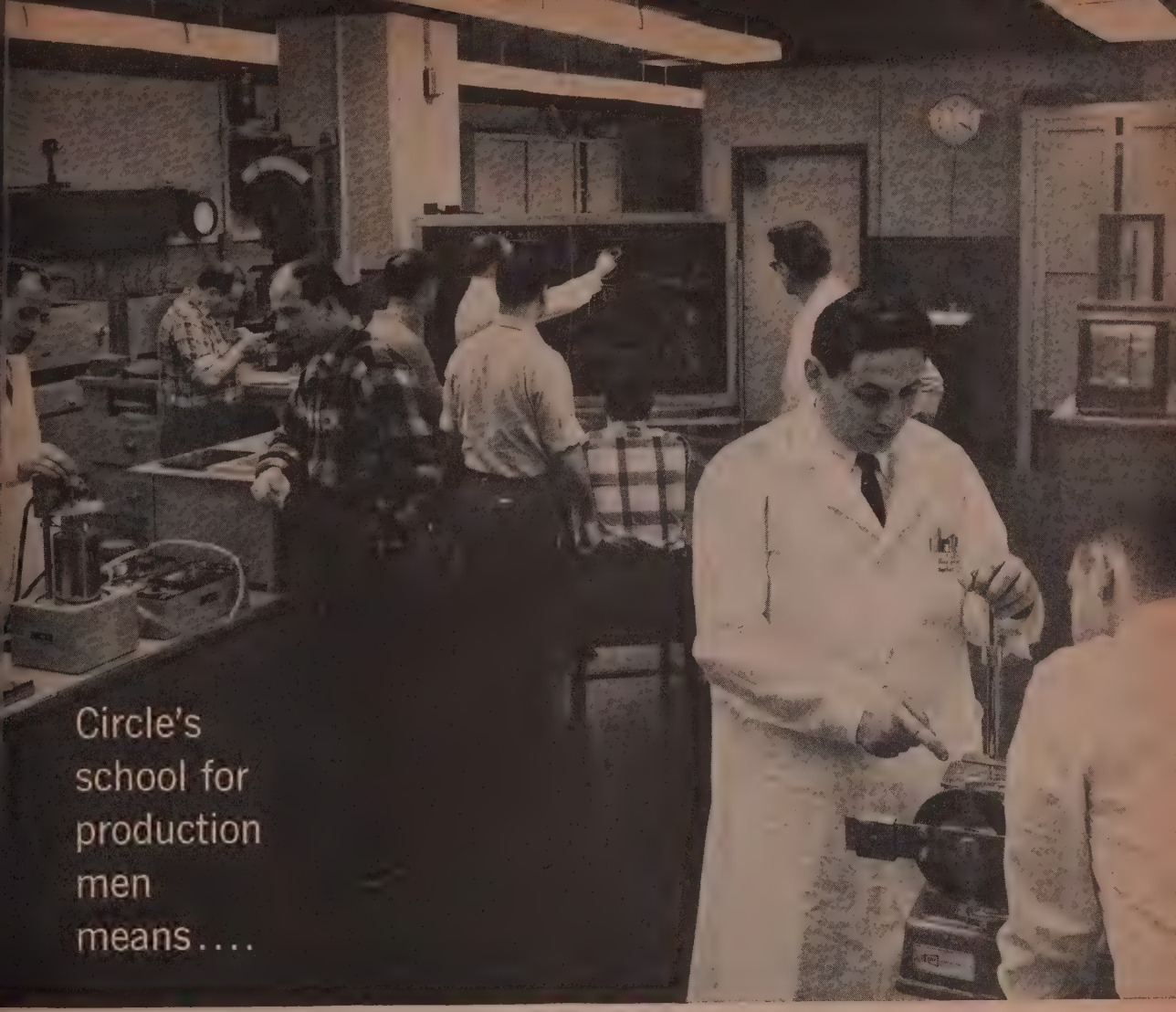
"Better regulation. We put a TRANFO-UNIT in every load area. So we get better voltage regulation for all our lights and equipment."

"Economy. We buy our power at economical higher voltages. Then we put the TRANFO-UNIT right near the load. Cables can be smaller size, lower cost."

"Flexibility. I-T-E gives us complete custom design service. TRANFO-UNIT components can be selected to meet our particular requirements."

For supermarkets, schools, office buildings, factories and many other applications, the I-T-E TRANFO-UNIT is ideal. Available from 45 through 2500 kva. For complete information, write I-T-E Circuit Breaker Company, Dept. TR, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY



BETTER WIRE AND CABLE FOR YOU

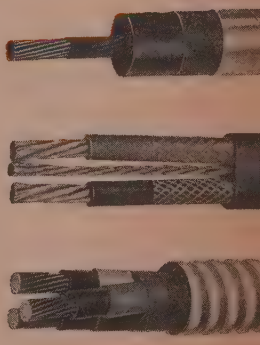
It isn't enough to build cable quality in the laboratory. There has to be follow-through in production.

And that calls for production men who not only care enough but *know enough* to consistently turn out top quality products.

That's why Circle production men "go to school." Periodically they attend lectures given by skilled laboratory technicians. They review such subjects as extrusion techniques, proper operating speeds, production line testing procedures, etc.

In-plant training such as this is unusual for wire and cable men. It is one of many reasons, however, why Circle products have achieved a reputation for high quality.

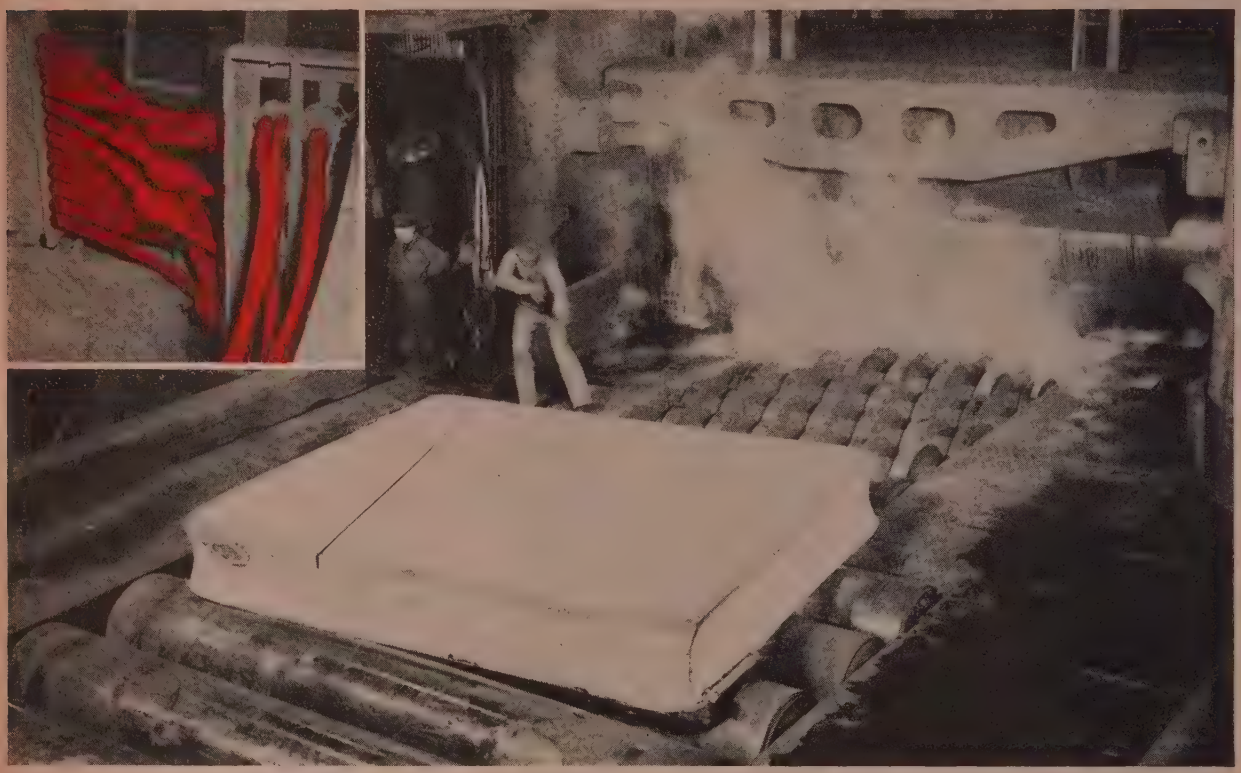
Next time you buy or specify cable, ask for Circle . . . there's no finer cable made. *Trade Mark



CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO CORPORATION

RUBBER COVERED WIRE & CABLE • VARNISHED CAMBRIC CABLE • PLASTIC INSULATED CABLE • NEOPRENE SHEATHED CABLE • CIRTUBE* EMT

Cable That Won't Quit



SILASTIC® survives torture... keeps production going

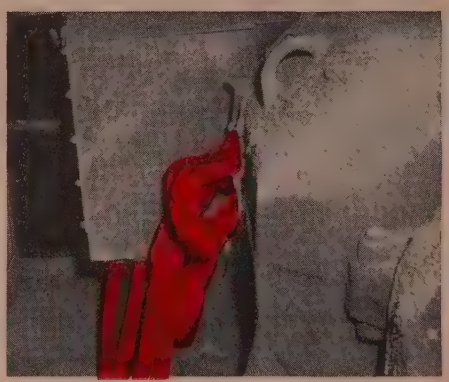
These photos, and the story behind them, provide an idea of the extraordinary service you can expect from cable insulated with Silastic, the Dow Corning silicone rubber.

The place: Lukens Steel Company. The installation: Exposed feeder cable for a 200 hp motor that powers America's largest plate rolling mill.

The mill operates around the clock, seven days a week . . . meaning the cable insulation is continuously subjected to some of the worst conditions imaginable: heat from the red-hot steel only a few feet away; hot "scale" off the steel; dripping grease; the salt used for cleaning the mill bed; and plenty of moisture.

No wonder it was necessary to shut down this mill at least once a year to service the cable . . . that is, until 1955 when a feeder cable insulated with Silastic was installed. Since then, there hasn't been a moment's downtime (or any lost production) due to cable service . . . for there just hasn't been any cable failure!

Could performance like this help whittle *your* annual maintenance bill . . . and keep production in high gear? What are your requirements for an insulation that increases cable life in almost any application and performs reliably despite such rough operating environments as in this installation? Leading manufacturers now offer power cable, control cable, hookup wire, fixture wire and building wire with insulation of Silastic. The latter two, of course, meet accepted UL standards. Want a list of these suppliers? Just write Dept. 3904.



Cable size: 500 MCM. Operates at 250 volts.

If you consider *all* the properties of a silicone rubber, you'll *specify Silastic.*

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS LOS ANGELES NEW YORK WASHINGTON, D. C.

fully magnetic, competitively priced . . . and now

GUARANTEED FOR LIFE

Murray "MP" Circuit Breakers

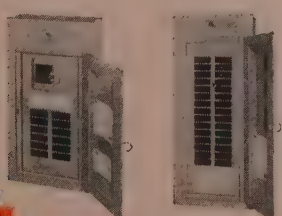
Build Business, Profits, Prestige!
Install the breaker that's best all around—best for you, best for your customers, and *Guaranteed For Life!*

You'll like working with "MP" breakers. *Fully magnetic* and unaffected by heat, these breakers never need derating, carry full rated load, never trip unnecessarily, can be installed anywhere it's most convenient for you or your customers.

Secondly, your customers will appreciate knowing that the breakers you install are *Guaranteed For Life.* It shows you're using the best, helps you get the business.

Extra Sales Aids For You!
You get a special Guarantee Certificate to leave with each customer plus a special sticker for your own promotion to use on each load center. This will boost your prestige, bring extra business your way.

Here's How You Can Cash In On This Guaranteed For Life Program!
See your Murray wholesaler today for full information on this precedent-breaking promotion. Ask him also about the material he has available to help you sell builders and homeowners on Murray *Guaranteed For Life* "MP" circuit breakers. Or write Murray directly for complete details.



60 YEARS Murray

Backed By A Full Line Of Load Centers

Murray Manufacturing Corp., 1250 Atlantic Avenue, Brooklyn 16, N.Y.
Dept. B-4

Gentlemen:

A circuit breaker that's *Guaranteed For Life!* I'm interested. As soon as possible, send me complete information on everything.

Name_____

Address_____

My wholesaler is_____

Armorlokt Cables are easy to install around bends or obstructions, readily accessible for repairs and are available for indoor and outdoor applications.

USS

Tiger Brand Electrical Wire & Cable

A standard cable for every special job

- Asbestos Wire and Cable
- Mold-Cured Portable Cord
- Shovel & Dredge Cable
- Paper & Lead Cable
- Varnished Cambric Cable
- Interlocked Armor Cable
- Special Purpose Wire & Cable
- Aerial, Underground and Submarine Cable

What's the difference in electrical cable?

You can install USS Armorlokt in half the time—at half the cost

Take a close look at the main illustration. With Tiger Brand Armorlokt Interlocked Cable, it's a simple job to run power and light lines around a steel beam. We know, from experience on other jobs, that a conduit system would require about twice as much time to install. It would probably have required larger size cable, because of the higher voltage drop . . . *and it would cost about twice as much!*

Greater current-carrying capacity. For a given conductor size, Armorlokt will have a higher current capacity than three single conductor cables pulled into a steel conduit. As an example, 500 MCM 3-conductor varnished cambric cable with galvanized steel interlocking armor will have a current-carrying capacity of 417 amperes with a copper temperature of 85°C. Three single conductors of the same size in a steel conduit will have a current-carrying capacity of 380 amperes. Putting it another way, 350 MCM Armorlokt might serve, where 500 MCM would otherwise be required in conduit . . . a big saving in favor of Armorlokt.

Less material—less space. With Armorlokt, costly pipe fitting, bending and pull boxes are eliminated. Installation time is cut approximately in half. Space savings as high as 55% to 75% over conduit are common.

Greater layout flexibility. When distribution systems are laid out with easily-accessible, readily-traceable Armorlokt Cables, it is a simple matter to change machinery locations. This might well be a deciding factor in industrial plants.

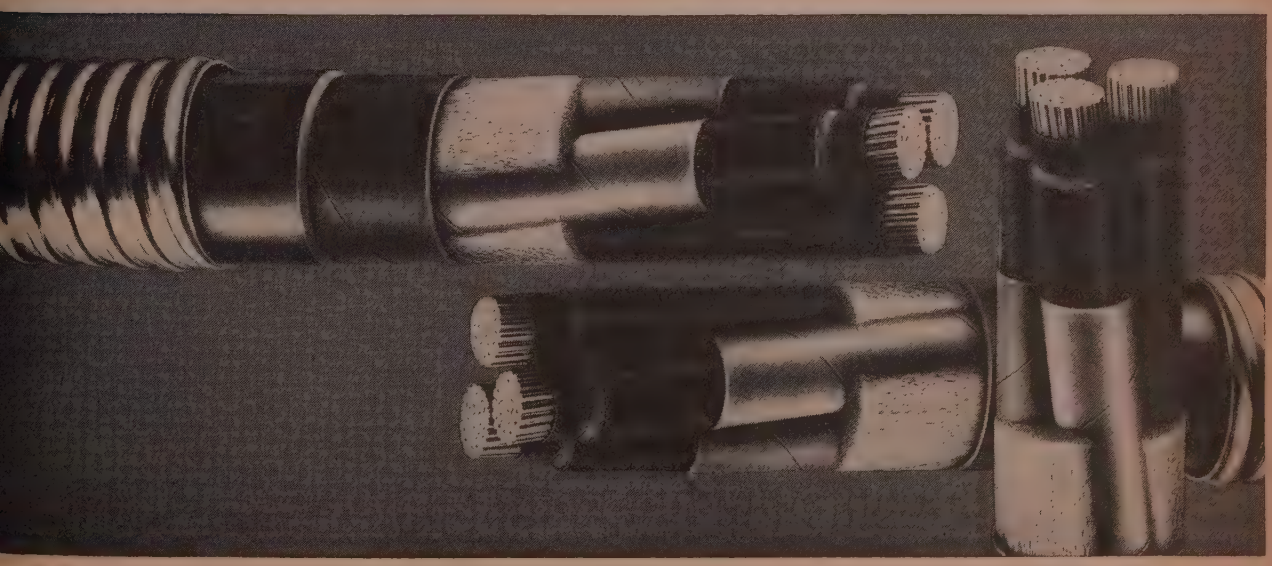
Ease of maintenance. Armorlokt Cable permits the greatest possible ease of maintenance. Cable faults are readily located and serviced. If Armorlokt should become damaged, you simply insert a splice box.

USS Tiger Brand Armorlokt Cable is available in voltage ratings from 110 to 15,000 . . . with galvanized, stainless steel, aluminum or bronze armor . . . with polyvinyl chloride jackets over the armor for especially corrosive applications. For complete facts, write American Steel & Wire, Dept. 0177, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

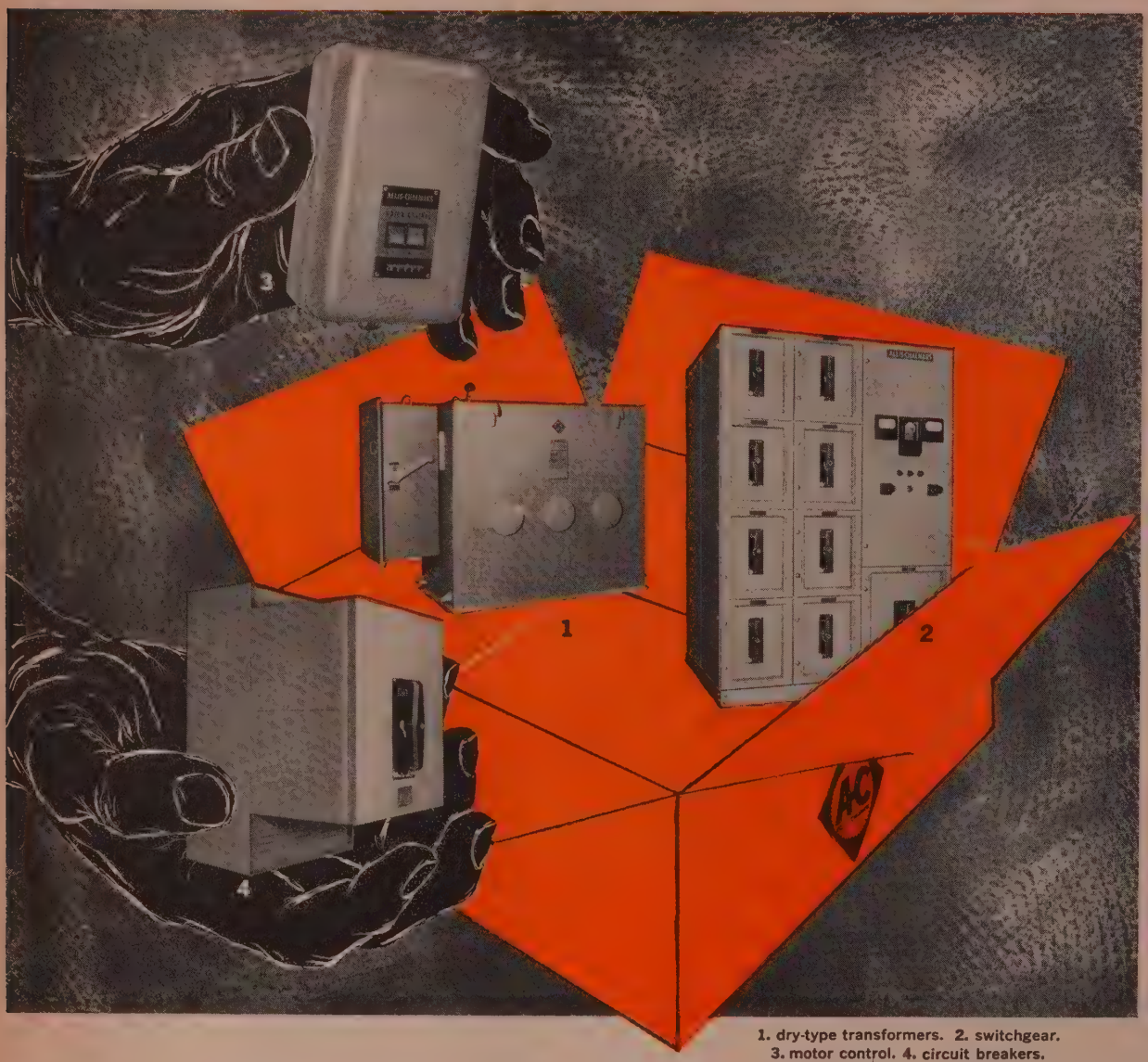
USS, Tiger Brand and Armorlokt are registered trademarks

American Steel & Wire Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors
United States Steel Export Company, Distributors Abroad



ALLIS-CHALMERS



1. dry-type transformers. 2. switchgear.
3. motor control. 4. circuit breakers.

Allis-Chalmers system-selling package concept

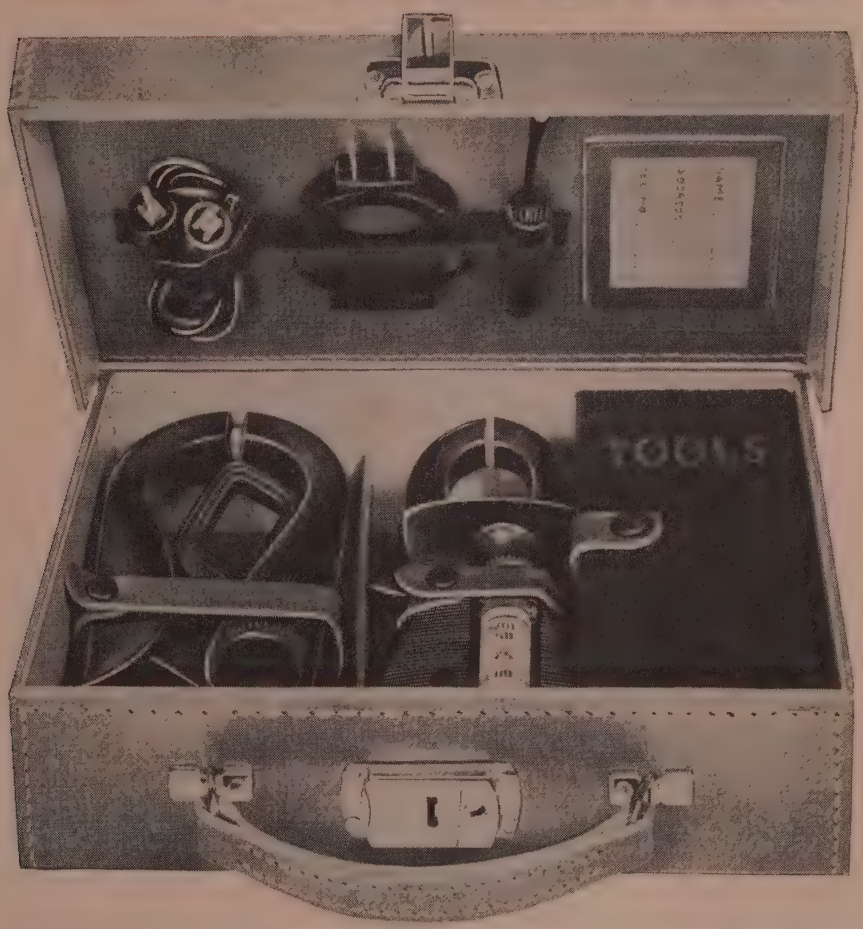
wraps up new profits for you

One man gives you all the electrical products for wrapping up new profits on system sales and installations! One man coordinates specs, orders, delivery, installation scheduling. One man personally represents Allis-Chalmers — exercises single-source responsibility from initial planning to startup and he is ready to follow through on fast spare parts action.

Why not wrap up new profits by eliminating needless multiple supplier headaches? You can accomplish this with the Allis-Chalmers system-selling packaged products shown on the following pages. *Your nearby A-C office can quickly give you the complete facts, or write* ***Allis-Chalmers,*** *Power Equipment Division, Milwaukee 1, Wisconsin.*

A-1267

All your answers are in the bag with PYRAMID



Amprobe Test-Master Kit keeps all equipment right at hand...handsomely.

Truly the sign of the professional, this rugged, good-looking, genuine cowhide case contains all the equipment *you* need to do all your electrical testing jobs with precision and accuracy.

Compact, neat and sturdy, the Test-Master Kit is specially designed to hold any one of the famous Amprobe RS models, the Amprobe Deca-Tran, the Amprobe Energizer and the Test-Master has a separate covered section to hold your small hand tools easily, within reach.

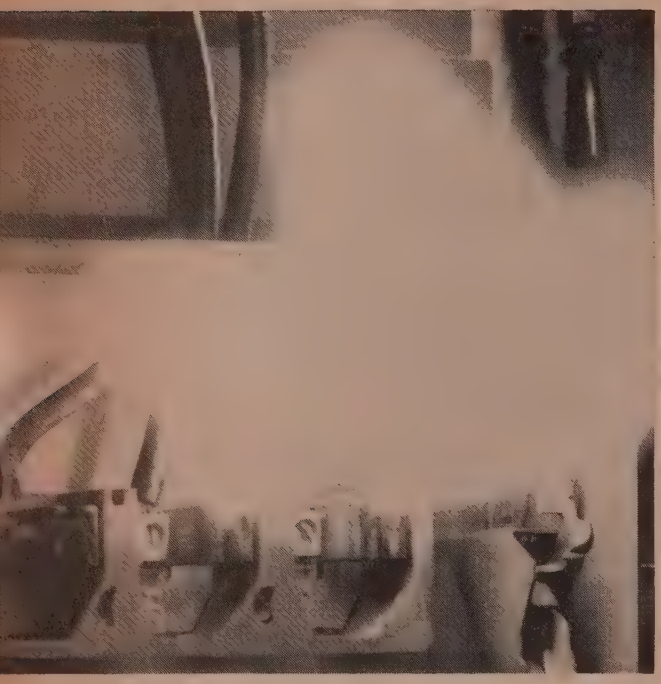
The Test-Master comes in two models: **TM33** contains the world-famous Amprobe RS-3 snap-around volt-ammeter-ohmmeter: 5 current ranges, 3 voltage ranges. Amprobe Deca-Tran: Extends amperage reading 10x, as high as 1200 amps. Amprobe Energizer: Multiplies sensitivity of any Amprobe 10x for readings on small appliance and fractional h.p. motors. **$84.50**

TM11 contains the Amprobe RS-1, economy snap-around volt-ammeter. Amprobe Deca-Tran and Amprobe Energizer. **$71.75**

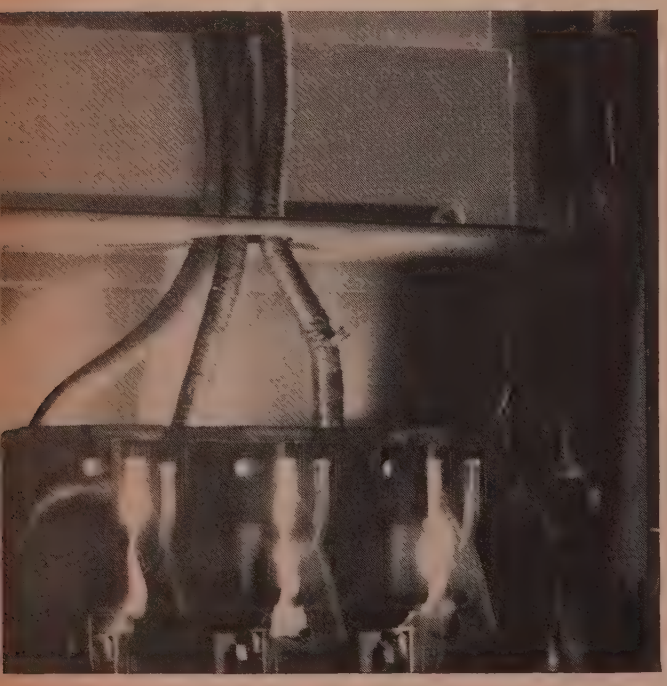
The Amprobe Test-Master Kit, RS-3, Deca-Tran and Energizer are all products of

PYRAMID INSTRUMENT CORPORATION, LYNBROOK, N.Y. WORLD'S LARGEST MANUFACTURER OF SNAP-AROUND TEST INSTRUMENTS

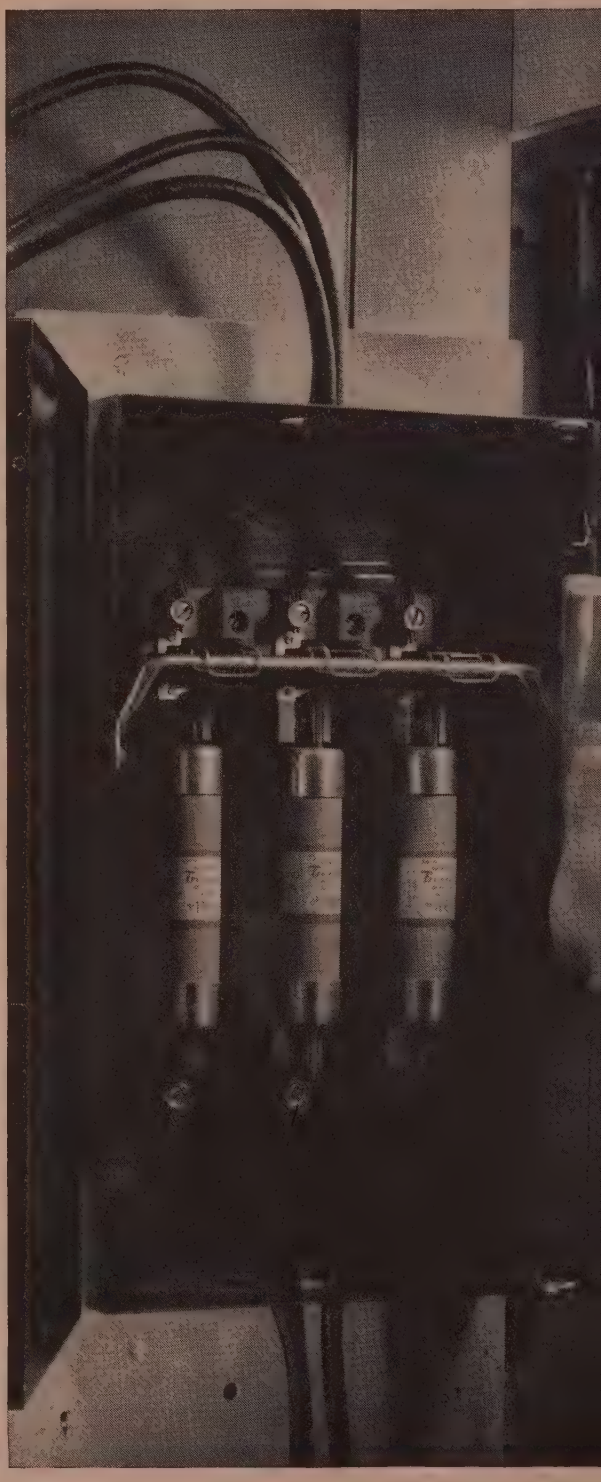
FOR SAFETY'S SAKE



1. RUINOUS ARC in open knifeblade switch. At moment of "break" a flash explosion occurs. Blades pit, burn, deteriorate. Danger of fire is ever-present in open blade switches.



2. SUBDUED ARC in modified knifeblade switch. Closures or "quenchers" retard arcing slightly, but since blades must ultimately be pulled clear of closures the hazards still exist.



3. MAXIMUM SAFETY found only in BullDog Vacu-Break* Saf Switches. Arcing is confined inside compact Vacu-Break chambe Arcs are snuffed out before they can cause any serious dama

Unretouched photographs of the arc in 100-amp 600-volt switches operating under 90-amp 440-volt load with 40% to 50% power factor. All pictures taken at exact instant of "break."

HERE'S THE REAL STORY ON SAFETY IN SAFETY SWITCHES

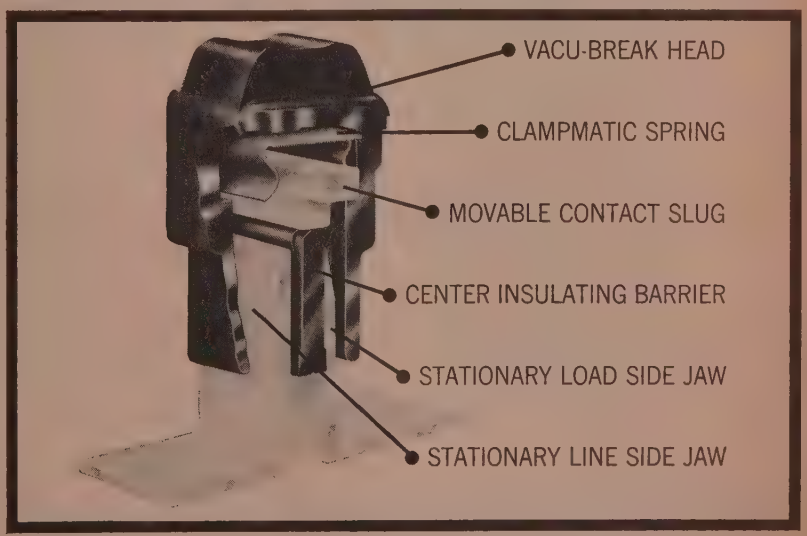
There's a big difference in safety switches—a difference between maximum safety and half-way safety . . . low maintenance and excessive maintenance. These differences are quickly apparent when you compare BullDog Vacu-Break® Safety Switches with the other main type —the open knifeblade switch.

BULLDOG discarded the knifeblade design twenty years ago when they engineered the Vacu-Break. It is based on the engineering principle that an arc is the least destructive or dangerous if confined in an arc chamber which limits the oxygen supply . . . actually starves the arc before it can build up. "Explosions" are non-existent . . . the need for maintenance of contact points is virtually eliminated. Today, only BullDog has the Vacu-Break or anything like it. And it is available at no extra cost on both the Master and Junior and Raintight lines.

OPERATION of the Vacu-Break is simple, sure and safe. A sturdy rod attached to the operating handle is clamped directly to the Vacu-Break heads. When the handle is pushed "Off," this rod literally yanks the heads away from the stationary contacts. *Double "break" action is quick, foolproof.* Unlike knifeblade types, you need not depend on tricky spring and trigger mechanisms. You don't have to open the switch cover and check to see that contact has been broken!

100,000 AMP TEST. BullDog Vacu-Break Safety Switches, when used with current-limiting type Amp-Traps**, will withstand the most severe fault currents. In recent tests standard BullDog switches with Amp-Traps have been subjected to a 100,000 amp short circuit current. *The switches were undamaged!*

THE CLAMPMATIC* ASSEMBLY (see the illustration below) is another safety feature of BullDog Vacu-Break Safety Switches. It gives bolt-tight contact in the "On" position, helps accelerate "break" when the switch is pushed "Off." You provide real value, too. Vacu-Break Safety Switches cost no more. Compare!



Close-up of Vacu-Break head shows movable contact slug inside the compact, oxygen-limiting chamber. Clampmatic assembly assures bolt-tight contact, speeds "break." This combination guarantees positive, safe operation, long switch life.

BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Michigan.
In Canada: 80 Clayson Rd., Toronto, Ont. Export Division: 13 East 40th St., New York 16, N. Y.

* *Vacu-Break and Clampmatic are registered trademarks of the I-T-E Circuit Breaker Company.*

** *Amp-Trap is a registered trademark of the Chase-Shawmut Company.*

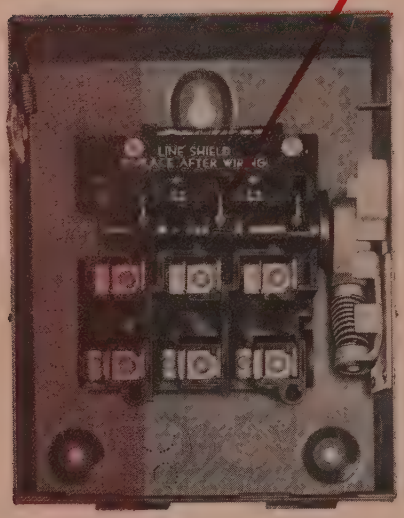
FOR SAFETY'S SAKE—BUY VACU-BREAK

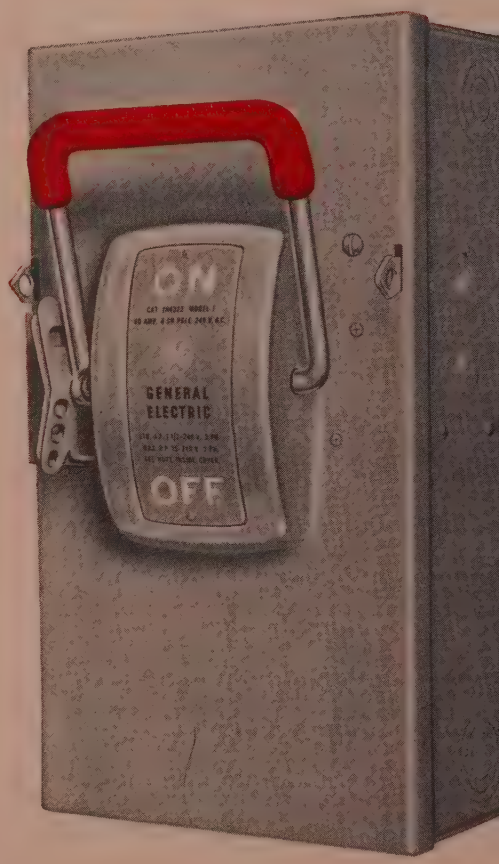
BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY

For extra safety...

GET THE SWITCH WITH THE RED HANDLE!

You can see the contacts— Silverplated blades are plainly visible, spring reinforced for full, firm electrical contact.





No wire abrasion
Side wiring gutter is unobstructed—free of moving parts which can chafe and wear wire insulation.

These features mean extra safety for you: Vivid red handle is insulated, provides ON-OFF identification from over 100 feet away; safety phase barrier protects against accidental contact with live parts; no fiber linkages in mechanism to deteriorate with age, moisture or heat; complete locking provision; mechanical interlock and line shield (Heavy Duty). Heavy Duty (Type A) sell at Normal Duty (Type C) price levels. Write for Bulletin CPD-74. See your G-E distributor for a demonstration.

GENERAL ELECTRIC

Circuit Protective Devices Dept., Plainville, Conn.

For contractors who want the finest . . .

Phelps Dodge Habirite-Habirprene Cable with Wire Shield!

Phelps Dodge pioneered the use of a wire shield as a standard item in power cable construction. From this background and experience, Phelps Dodge developed its outstanding Habirite-Habirprene high voltage cable with a wire shield. This cable offers a number of advantages over ordinary "RR" cable with tape shield including:

1. Greater flexibility; minimum bending radius in most cases is less than half the bending radius of tape-shielded cable, making installation easier in confined areas.
2. Rugged wire shield can be braided or bunched for use as a ground lead at splices and terminations. Intermediate steps in making ground connections are eliminated, saving time and effort.
3. Dependable wire shield continuity provides protection against hidden shield rupture which can occur during installation or in service.
4. Overall wire shield resistance is constant without the variations found in tape-shielded cable.

Habirite-Habirprene cable with a wire shield assures you the utmost in safety, durability and handling ease.

See your Phelps Dodge Distributor!

PHELPS DODGE COPPER PRODUCTS CORPORATION

300 PARK AVENUE, NEW YORK 22, N. Y.

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N.C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D.C.

Look! Improved cam action A-C switch "quiet as new"

See the 5 extra-quality features you get in the

1. Notice there are no "bumpers" of elastic material, such as those used in other a-c switches to quiet noisy toggle actions. Bumpers make switches noisy when they harden with age.

General Electric uses a completely different design, that's quiet to start with . . . and stays that way. Its crosswise spring (a) provides positive ON or OFF "throw", by slipping firmly into curved depressions (b or c) in the bottom end of the handle. A cam on the handle (d) raises and lowers the sprung contact arm — for smooth, dependable operation of silver contacts (f). You get a mechanism with fewer moving parts, that lasts longer — remains quiet for the life of the switch.

keeps this new General Electric —gives it longer life, too!

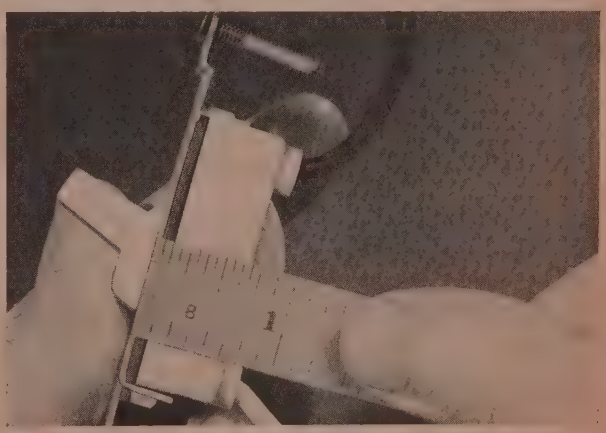
GE5451-2 20-A, 277-V Specification grade A-C switch

2. See the special, arc-resistant construction. The body of this switch is non-tracking, urea-base plastic — that resists charring and won't support arcing the way ordinary phenolic plastics sometimes do. Its heavy-gauge mounting strap is colored gold, to show you at a glance that this is a 20-A switch.

3. Check the tighter electrical and mechanical terminations. Laboratory temperature-rise tests prove that G-E Pressure-Lock* terminals make better electrical connections than screw types. Pull-out tests prove they grip tighter. They take Nos. 14, 12 or 10 Awg wire; release quickly with a screwdriver.

**Trade-mark of General Electric Company*

4. Note the increased safety you get, too. Back-wired, Pressure-Lock connections don't work loose under normal vibration, temperature changes, or when you push the switch into the box. Cam action keeps its grip on the wires. Pressure-Lock terminals are also totally enclosed, to protect against grounds and shorts.



5. Look at the extra room you get for wires in the box. This shallow G-E switch sticks into the box only 1 5/16" — relieves crowding — reduces chance of shorts. Captive 7/8" plaster-cleaning mounting screws help make it a real pleasure to install. Listed by U.L., meets Federal and REA specifications.

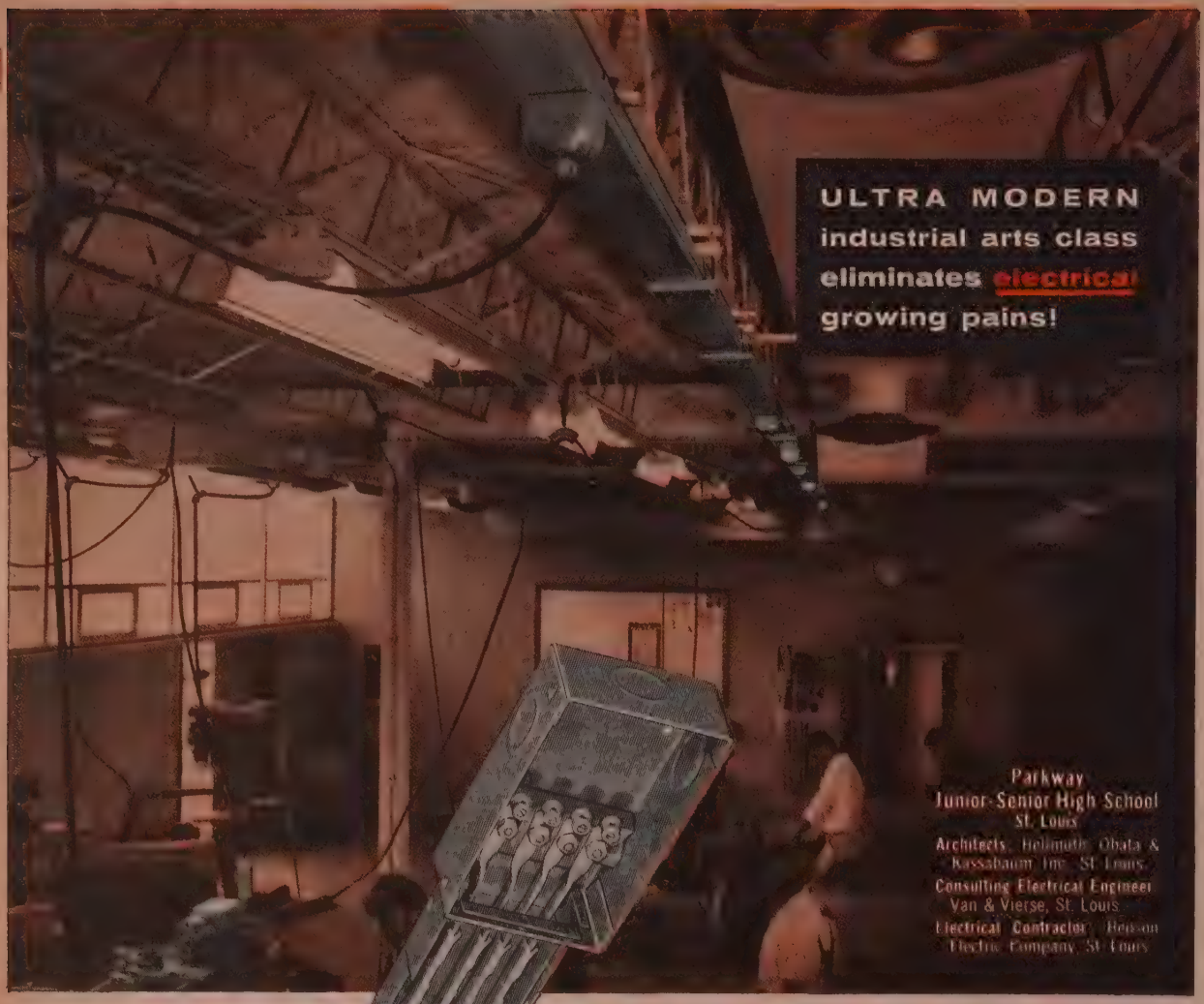
There *is* a difference in wiring devices. The best way to see it for yourself is to take this or *any* G-E Specification Grade wiring device apart. Compare it with other brands.

See and feel the extra *quality* that General Electric gives you; new ideas in each device!

Your G-E distributor will be glad to help you see these differences for yourself. General Electric Company, Wiring Device Department, Providence 7, Rhode Island.

Progress Is Our Most Important Product

GENERAL ELECTRIC



FRANK ADAM MIDGET POWERPLUGIN BUSDUCT

Hangers—One for each 5 ft. of busduct. For ceiling or side wall installations.

Plugin Device—Two spring prongs attached to device, catch and lock on the inside of duct to form a rigid support. Also act as ground connection to duct.

Plugin Outlets on 12" Centers—Provide electric power where it's needed, when it's needed. 100 amps., 250 volts or less.

A perfect example of how Frank Adam Midget Powerplugin Busduct keeps pace with the future!

Present classroom equipment can be moved and plugged-in almost as easily as an electrical appliance . . . the busduct quickly relocated if necessary. If additional busduct is needed for future expansion, it can simply be added to the old! Cuts costly rewiring—keeps electrical downtime to a minimum.

For an economical and versatile electrical power supply that will stay modern for years to come, specify and insist on quality built Frank Adam Midget Powerplugin Busduct.

FRANK ADAM ELECTRIC COMPANY
P. O. BOX 357, MAIN P. O. · ST. LOUIS 66, MO.

busduct · panelboards · switchboards · service equipment · safety switches · load centers · Quikheter

ENJAY DELIVERS 1,000,000th LONG TON OF BUTYL!

PRODUCTION FACILITIES INCREASED TO MEET CONSTANTLY GROWING DEMAND

There have been many elastomers developed since the first commercial ton of Butyl was used in 1943, but no other rubber, synthetic or natural, offers so many outstanding properties for so many applications.

Plant expansion plans announced recently will increase butyl production capacity some 50 percent by 1961 and, at today's rate of consumption, the two million-ton mark will be reached within the next six or seven years. Two new additions to the butyl product line, Chlorobutyl and Butyl Latex, will soon be available in commercial quantities.

VERSATILE ENJAY BUTYL'S OUTSTANDING PROPERTIES MAKE IT SUPERIOR TO OTHER RUBBERS FOR MANY APPLICATIONS. SOME ADVANTAGES:

- **RESISTS TEAR AND ABRASION** ... used in the new and revolutionary all-butyl tire.
- **STANDS UP AT HIGH TEMPERATURE** ... used in steam hose and tire curing bladders
- **HAS EXCELLENT ELECTRICAL PROPERTIES** ... used in high voltage cable insulation
- **IS IMPERMEABLE TO GASES** ... used in virtually all rubber air-holding applications
- **HAS WIDE RANGE OF DYNAMIC PROPERTIES** ... used in over 100 applications on the modern automobile
- **DISPLAYS OUTSTANDING CHEMICAL RESISTANCE** ... used for the storage and shipment of many chemical and commodity products
- **WITHSTANDS EXPOSURE TO SUN AND WEATHER** ... used in irrigation pipe and roof coatings.

Want to find out fast, how versatile Butyl can improve your product? Call or write the nearest Enjay office.

ENJAY BUTYL

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

ENJAY COMPANY, INC.

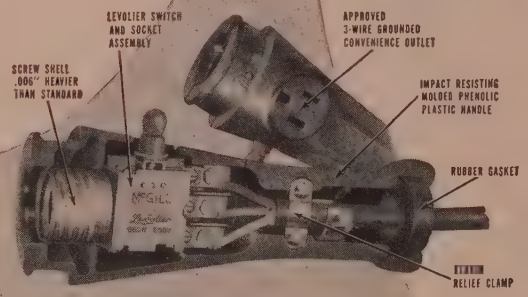
15 West 51st Street, New York 19, N.Y.

Akron • Boston • Charlotte • Chicago • Detroit • Los Angeles • New Orleans • Tulsa • Toronto

McGILL® PORTABLE LAMP GUARDS are always a little better ...and all are UL inspected

- Rugged, steel wire cage. Spot-welded with extra heavy zinc plated, chromate finish.
- Tough, gray molded phenolic handle resists impact, heat oils, greases, some acids, moisture and abrasion.
- Concentrating end lens. • Convenience hook.
- Approved 3-wire grounded convenience outlet.
- Exclusive McGill LEVOLIER Switch. • Rotary reflector.

No. 5000 SLRG



An extra margin of quality is designed and built into the complete line of McGILL industrial portable lamp guards for safe, dependable utility. Rugged, heavy duty construction and selected materials withstand the punishment of rough use. The famous McGILL LEVOLIER switch mechanism provides a degree of dependability not found in ordinary portables. It's economical to specify the best.

More than 100 different types of McGILL portable lamp guards have been developed to meet the particular requirements of a wide range of service conditions. Cages 50 to 200 watt. 660 watt, 250 volt sockets.

For detailed descriptions of the McGILL line of top quality electrial specialties, including portable lamp guards, and Levolier switches write for McGILL ELECTRICAL SPECIALTIES CATALOG No. 84.

No. 7100 SR Lamp Guard

Thumb clamp arrangement for cage to change lamps quickly without tools. Gray Neoprene-butyl handle; reflector; LEVOLIER switch.

No. 5025 SRG Service Light

Completely grounded service light. 15 amp., 125 volt convenience outlet built into molded phenolic handle. Safe on-the job source for power tools. Levolier switch and 25 ft. 16-3-SJ gray rubber cord.

No. 5000 SR Lamp Guard

With 15 amp., 125 volt convenience outlet in impact and heat and grease-resisting positively insulating molded phenolic handle. No-Rol cage, Levolier switch and reflector.

No. 3006 Vaporproof Lamp Guard

Watertight, vaporproof and moistureproof for complete safety. Heat and impact resisting glass globe screws into a silicone rubber gasket. Handle molded of macerated phenolic.

No. 652 Lamp Guard

Rubber hook handle, thumb release clamp for easy bulb replacement. Can be hung, for maximum light, from hook or handle.

Write for Free McGill Catalog No. 84

engineered electrical products

McGILL®

precision needle roller bearings

McGILL MANUFACTURING COMPANY, INC., ELECTRICAL DIV., 450 N. CAMPBELL ST., VALPARAISO, INDIANA

EW! NEW! NEW! NEW! NEW

THE NEW CUTLER-HAMMER

safety breaker

CH CONTROL

The modern "housepower" protection you are proud to make convenient!

Contractors know *most* people prefer the protection circuit breakers provide for wiring. The majority of new homes being built have breaker panels.

Contractors also know *most* people prefer to make such protection convenient. New home plans should put the breakers in or near the kitchen where they belong. Frequently, however, people try to *hide* their breaker panel because of its appearance. When you hide anything, you have to *hunt* it when you need it . . . and that's *not* the way to get convenience.

Cutler-Hammer has done something about this in designing the new Cutler-Hammer Safetybreaker! It's appliance-styled to match the finest kitchen equipment. Its muted sandalwood finish is just what women prefer. This new Safetybreaker is truly the modern "housepower" protection you are *proud* to make convenient.

See the excerpt at right from *American Standard Requirements For Residential Wiring* sponsored by the "Industry Committee on Interior Wiring Design" with the approval of its participating organizations.

American Home Lighting Institute
American Institute of Electrical Engineers
American Society of Agricultural Engineers
Edison Electric Institute
Illuminating Engineering Society
International Association of Electrical Inspectors
National Association of Electrical Distributors
National Association of Home Builders
National Electrical Contractors Association
National Electrical Manufacturers Association
Radio, Electronics and Television Manufacturers Association

"Because of the many uses of electricity in the kitchen requiring individual-equipment circuits, it is recommended that the electric service equipment be located near or on a kitchen wall to minimize installation and wiring costs."

AMERICAN STANDARD REQUIREMENTS FOR RESIDENTIAL WIRING
ASA C91.1—1958; UDC 621.315.3:728; AIA File No. 31-C-61

Easiest to install . . . a C-H Safetybreaker saves you time and effort on every job.

- Three point keyhole mounting assures perfect case alignment.
- Plenty of wiring room . . . no wire guides to skin your knuckles.
- Box type lugs on all terminals end wire *pretzel bending*.
- Power terminals accept both copper and aluminum cable . . . no extra cost.
- No chance for error, bus design assures proper phase balancing.
- Solid bus bars eliminate troublesome current-carrying joints.
- Sure-grip Safetybreakers snap into position . . . your screwdriver never need touch the *hot side* of the line.
- Front adjusting leveling device provides a firm non-vibrating base for the bus mechanism.
- Twist-out louvers always maintain a neat appearance . . . no thin dividers to complicate blank removal or cover-to-breaker alignment.

The new Cutler-Hammer Safetybreaker is as new in its features as in its appearance. Comparison proves its superiority. See it now!

New electronically calibrated, *fast-trip* magnetic-thermal Safetybreakers . . . provides positive circuit protection from direct shorts and build-up overloads.

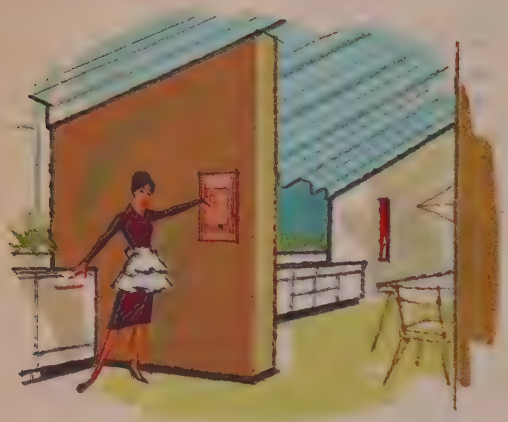
Contrasting handle flags the overloaded circuit. No in-between trip point. A C-H Safetybreaker is either *on* or *off* . . . just like a light switch.

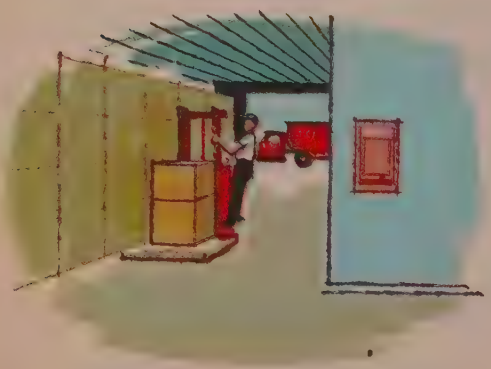
Cutler-Hammer Safetybreakers offer non-interchangeability provision

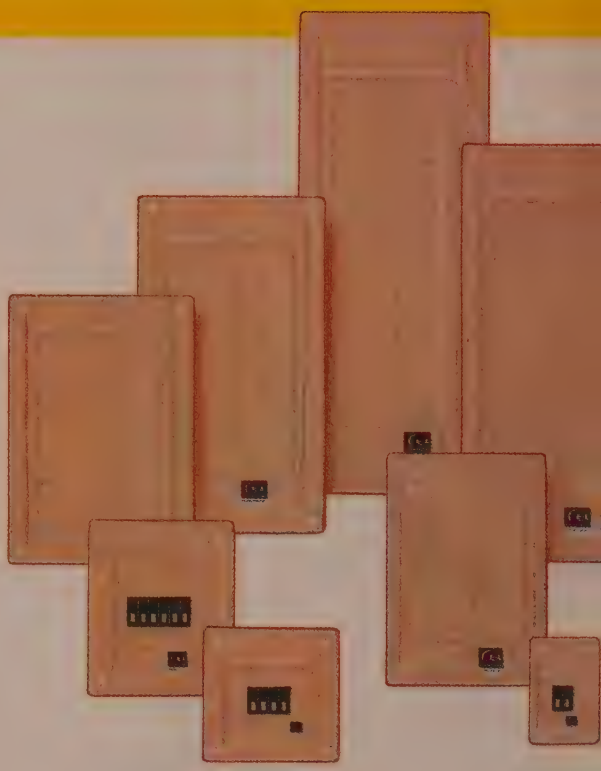
The all new Safetybreaker is your best buy for every job . . . yes, even those that call for non-interchangeable circuit breakers. The non-interchangeability feature of the C-H Safetybreaker is an integral part of its all-new design . . . not a mere design modification. There are *no* extra parts or adapters to be added each time a breaker is installed . . . *no* mounting pins or tabs to be removed . . . *no* chance for errors—you can't make a mistake . . . *no* additional expense to you during installation.

...for extra value at no extra cost

Install the new Cutler-Hammer Safetybrea

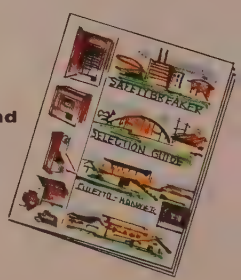






Now available in every needed size and type of service entrance and load center; Cutler-Hammer Safetybreakers range in size from 2 to 42 circuits; 40 to 200 ampere capacity; series, parallel, and split-bus construction; single phase 3 wire and three phase 4 wire.

Write today for the new "Safety-breaker Selection Guide". You'll find it most interesting and informative. Ask for Publication ED125-G241. Cutler-Hammer Inc., Milwaukee 1, Wisconsin



CUTLER·HAMMER

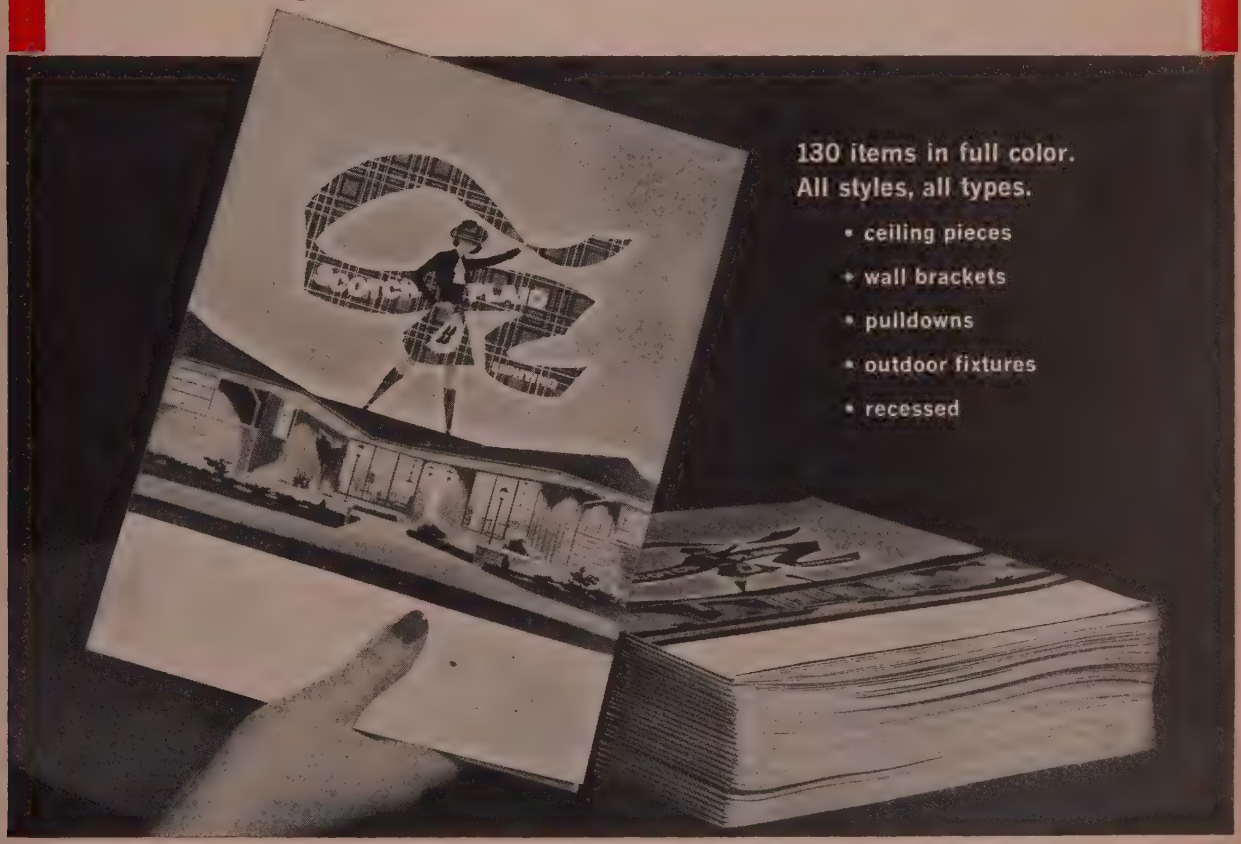
Cutler-Hammer Inc., Milwaukee, Wis. • *Division:* **Airborne Instruments Laboratory.** • *Subsidiary:* **Cutler-Hammer International, C. A.**

Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.; Intercontinental Electronics Corporation.

virden Presents the NEW line of SCOTCH PLAID LIGHTING

Beauty *PLUS* Economy...

From Virden, famous for quality, comes a new and separate line of lighting fixtures. Called Scotch Plaid Lighting, here is beauty in design, excellence in workmanship, at a truly economical price! Ideal for tract homes or low-cost housing. Excellent for remodeling, wherever you want high-style at budget prices. See the new Scotch Plaid Lighting line at your nearby Virden distributor. Ask him for your copy of our new, free, full-color catalog. Or mail the coupon below.



See your Virden distributor or mail the coupon today!

VIRDEN LIGHTING

A Division of the John C. Virden Company
Cleveland 3, Ohio

Member American Home Lighting Institute

In Canada, John C. Virden Ltd., Toronto, Ontario

Virden Lighting, Dept. ECM-4
5209 Euclid Avenue
Cleveland 3, Ohio

Please send me your free Scotch Plaid Catalog SP-160.

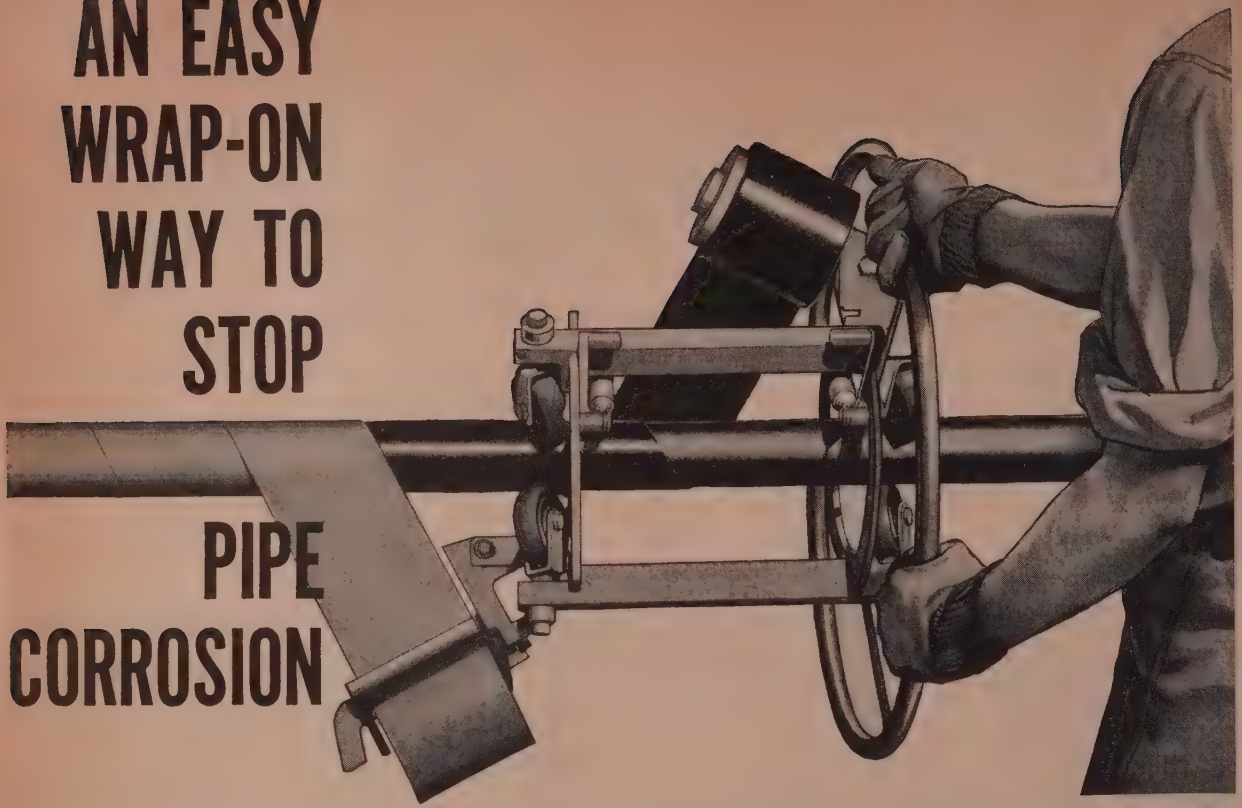
Find It Fast In The Yellow Pages

Name_____

Address_____

City_____ State_____

AN EASY WRAP-ON WAY TO STOP PIPE CORROSION



The new CORR-PREV Pipe Coating Team comes in easy to handle tape form. It goes on pipe faster and lasts longer than corrosion-proof paints. It's cleaner and simpler to apply, too, than hot tar coats. And most important, this new CORR-PREV Team offers all the cost-cutting, pipe-saving advantages of *polyethylene* tape.

With CHASEWRAP Abrasion-Resistant Overwrap and Chasekote polyethylene tape, you get the easiest and best pipe protection at *lowest applied cost!* There's no heating, drying, clean-up or shut-down time. Each roll is factory-uniform in thickness and quality. And all coating materials — including rental of high-speed applicators — are available from one reliable source. Want samples? Specs? Prices? Write **CHASE & SONS, INC., 26 Spruce St., North Quincy, Mass.**

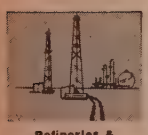
Chasekote*

Pressure-Sensitive Polyethylene Tape has an extra-heavy adhesive mass that clings to clean pipe on contact . . . makes a perfect, permanent bond that rustproofs, waterproofs and insulates pipe against all types of corrosion.

Chasewrap*

Protective Overwrap is a tough, wrinkle-free outerwrap that shields against abrasion, wear, and physical damage to the tape. Wraps simultaneously with the tape. Superior to rag and felt wraps, yet far lower in cost.

**Trade name of Chase & Sons, Inc., long-famous for protective and insulating tapes for electrical wire and cable*

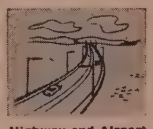


Refineries & Gathering Systems

Public Building Lines

Oil & Gas Transmission Lines

CORR-PREV DIVISION



Highway and Airport Conduit & Pipe

Utility Distribution Systems

Chemical & Industrial Plant Piping

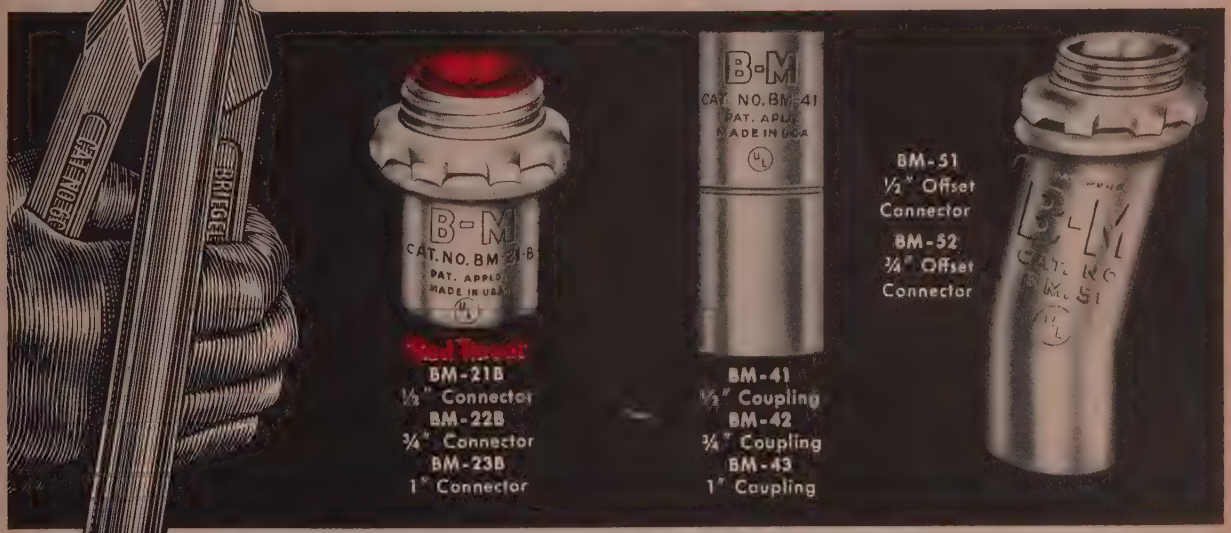
FOR YOUR ELECTRICAL INSULATION PROBLEMS SPECIFY CHASE FRICTION, PLASTIC, RUBBER, NEOPRENE AND BUTYL TAPES

It's a Breeze!

Just a *Double Squeeze*

Sets Up E. M. T.

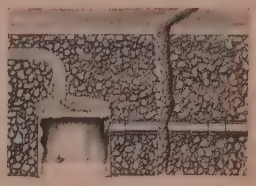
With Original B-M Indenter Fittings



B-M Indenter Fittings and Tools make an unbeatable combination when it comes to easier E.M.T. installation at less cost. New lightweight plier size indenters make setting up thin wall conduit a breeze. B-M fittings are neater too! No unsightly nuts or projecting set screws. Other plus features of B-M fittings are Concrete tight—Vibration resistant—Extra heavy bright zinc plate, salt spray and acid drip tested for corrosion resistance—Extra heavy positive bonding locknuts—Smooth rounded edges or bushed throat type connectors that prevent insulation damage—All steel construction with extra heavy gauge wall thickness.

B-M Offset Connector, showing how wires are guided over box edge.

Briegel All Steel Indenter Fittings are U.L. approved as Concrete-Tight.



BRIEGEL METHOD TOOL CO.

GALVA, ILLINOIS

All B-M indenter type fittings far exceed the requirements of U. L. file card E 10863 and Federal Specifications W-F-406.

TELESCOPE BM SYSTEM

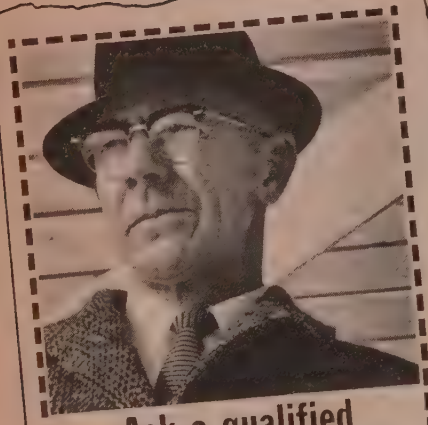
UL

USED THE MOST FROM COAST TO COAST

Announcing

OPERATION Support for YOU!

Now . . . 3M — makers of SCOTCH No. 33 Electrical Tape — announces a new promotion to support you . . . the electrical contractor!



Ask a qualified electrical contractor

Plan now to install adequate electrical wiring in your house or business to enjoy all the advantages of modern "electrical living." The safest surest way to get a completely satisfactory job is to rely on a qualified electrical contractor. He has the up-to-date knowledge, trained personnel, and specialized equipment to give you the best job for your money. And because he knows that *any electrical circuit is only as safe as the insulations that contain it*, you can depend on an electrical contractor to use only the best quality materials . . . like "SCOTCH" BRAND No. 33 Electrical Tape.

KEEP PACE ELECTRICALLY

LIVE BETTER ELECTRICALLY

SCOTCH No. 33 BRAND

. . . preferred by most electricians . . . everywhere!

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO.

MINNESOTA MINING AND MANUFACTURING COMPANY ST. PAUL 6, MINN.

3M COMPANY

OVER 23,000,000

readers are exposed to each of these "SCOTCH" No. 33 ads in THE SATURDAY EVENING POST!

STRONG ADS LIKE THIS which build business, confidence and public goodwill for you . . . are now appearing in THE SATURDAY EVENING POST!

Now 3M not only gives you "SCOTCH" BRAND No. 33—the top all-around plastic electrical tape—they also give you business building advertising support! These ads, on a regularly scheduled basis, are appearing now in the leading opinion-making magazine—*The Saturday Evening Post*—reaching your best prospects for wiring and rewiring jobs among householders and business and industrial management. Each ad supports you directly as the man to see for the best wiring job for any purpose. Watch for these ads in *The Saturday Evening Post!*

REG. U.S. PAT. OFF.

SCOTCH NO. 33

BRAND

. . . preferred by most electricians . . . everywhere

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL 6, MINN. EXPORT: 99 PARK AVE., NEW YORK. CANADA: LONDON, ONTARIO.

Electrical Products Division

MINNESOTA MINING AND MANUFACTURING COMPANY

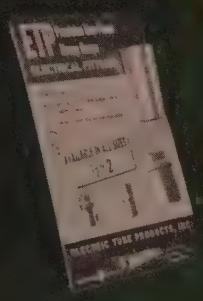
. . . WHERE RESEARCH IS THE KEY TO TOMORROW

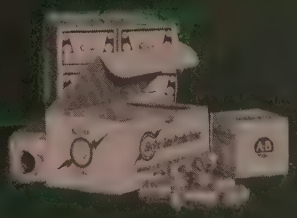
3M COMPANY

"I'm glad to see you sell the finest...

E·T·P

QUALITY FITTINGS!"



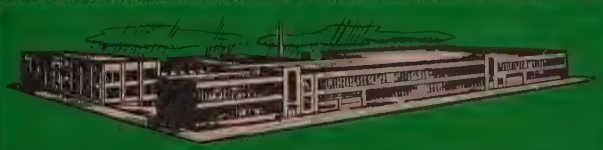


Contractors & Wholesalers Agree-E·T·P is the BEST Fitting Buy!

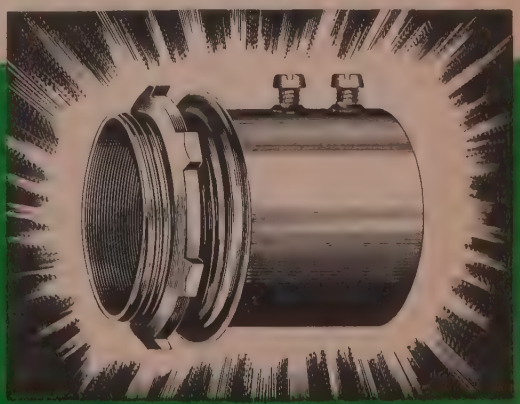
ETP is fast becoming the No. 1 preferred fitting in the electrical industry. The reasons are simple. **PRICE!** ETP fittings are **consistently competitive, consistently superior! QUALITY!** ETP fittings are concrete tight — one piece solid tubular steel — cannot open or spread. There are no finer made! **EASY ASSEMBLY!** Exclusive pre-set screws, staked screw with deep slotted head for working in tight areas. No backing out to insert conduit.

- Tough zinc chromate over-plating retards corrosion. Salt spray tested.
- Every fitting individually tested for uniformity and concentricity.
- Concrete tight — U.L. File Card E 24788.
- Precision bevelled edges with extra heavy duty locknut.
- Heaviest gauge wall thickness with precision rolled thread.
- Available in all sizes from ½" to 2"

Connect with ETP for Economy



Samples and Brochure on Request.



ETP

ELECTRIC TUBE PRODUCTS • 74-16 GRAND AVENUE, MASPETH, (N.Y.C.) N.Y. • DEfender 5-8000

Costs a *little* more

...gives MUCH more

To have fixture BALLASTS that wear this Certification emblem may cost a **little** more, than for non-certified ballasts . . . but you get MUCH more.

More and better materials in the ballast itself . . . more copper, more steel, and more protective and corrective devices . . . and more inspections, finer workmanship . . . to assure the user "tops" in fluorescent performance. Perhaps this extra value is why an ever increasing number of ballast users find that specified CBM performance . . . checked and certified by ETL . . . is well worth having.

CBM CERTIFIED by ETL ®

Get the full story: Write for a copy of "How to protect your lighting investment", **CERTIFIED BALLAST MANUFACTURERS,** 2118 Keith Building, Cleveland 15, Ohio.

Participation in CBM is open to any manufacturer who wishes to qualify.

3-60

New switch for matchless safety

Now, for the first time, the new American Electric Type "ND" Safety Switch offers *all* of the features "most wanted" in *one* safety switch by people who work with and use electrical equipment.

Included among the many "extras" to be found in this newest of safety switches are: visible double blade construction; positive, snap-action make and break; double insulation between blades and operating mechanism; optimum-size enclosures for maximum heat dissipation; plenty of wiring space for easier, faster installation; and an exclusive safety-yellow operating handle for quick, positive "spotting" even in poor light.

These and countless other field-tested design standouts assure the ultimate in safety switch protection with maximum operating life.

This new American Electric Normal Duty Safety Switch is, in fact, the result of the same kind of thorough engineering research and workmanship which has long made Clark Controller *"the standard of quality"* for industrial electrical control.

It meets NEMA standards for normal duty industrial and commercial use and is approved by Underwriters' Laboratories for these applications as well as for service entrance equipment. It is currently available in 30-ampere and 60-ampere, 250-volt and 600-volt ratings, both fusible and non-fusible.

Bulletin 250-ND fully describes every detail of this new switch designed for "matchless safety". For your free copy see your nearest American Electric Switch—Clark Controller Company distributor. Or, write direct. 9851

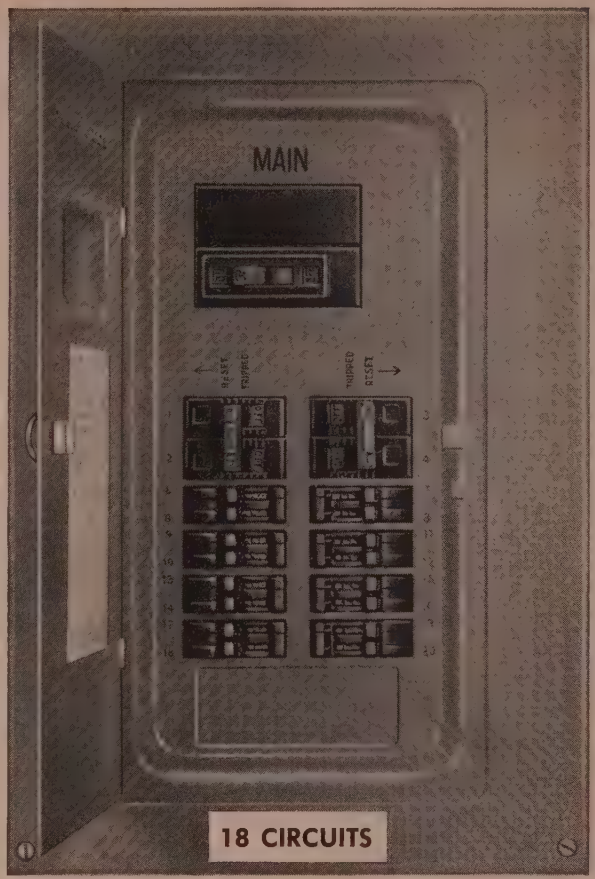
American
ELECTRIC SWITCH DIVISION

The **CLARK CONTROLLER** *Company*

Everything Under Control • 1146 East 152nd Street • Cleveland 10, Ohio

Same box - 8 extra circuits

General Electric TRM1210S "twin"* load center wired with two double-pole TQL plug-in breakers and eight single-pole plug-in TQL's.



Same load center wired with two double-pole TQL's and *sixteen* General Electric Type TR "twins" — two rugged breakers in a one-inch case.

Install more circuits, buy a less expensive box, with

General Electric "twin" circuit breakers

NEW

70 and 100-amp plug-in breakers

Perfect for sub-feed panels or main disconnects (back-fed). Protected female stab receptacles grip tightly; can't bend; plug-in without jiggling. All current-carrying parts silver-plated for cool, safe operation.

PROTECTING MEDALLION HOMES EQUIPPED BY GENERAL ELECTRIC

The "twin" lets you put up to twice as many circuits in the same space—because the "twin" is actually *two* rugged plug-in breakers in a single one-inch case.

Combined with other top-quality G-E breakers, the "twin" gives you complete flexibility in circuit arrangements. It is interchangeable with General Electric Type TQL single-pole and 2- and 3-pole common-trip breakers. Ask your G-E Distributor to show you how General Electric's "twin" can save you money on your next job.

*Trade-Mark

GENERAL ELECTRIC

CHANNEL MASTER ALUMINUM EMT

COSTS LESS THAN STEEL!

Channel Master Aluminum EMT provides the advantages you want. It costs less to buy... looks better longer... speeds up the job!

For a price below that of steel, you can have Channel Master Aluminum EMT, the lightweight tubing that *stays* good looking ...mirror bright, mirror smooth... inside and out. Aluminum EMT won't ever show its age.

Packaged in standard 10-foot lengths, chamfered at both ends, it is also easier to cut, bend, and put together. The hard-drawn, seamless raceway facilitates fishing and wire pulling. Standard inside and outside diameters match all U.L. approved EMT fittings.

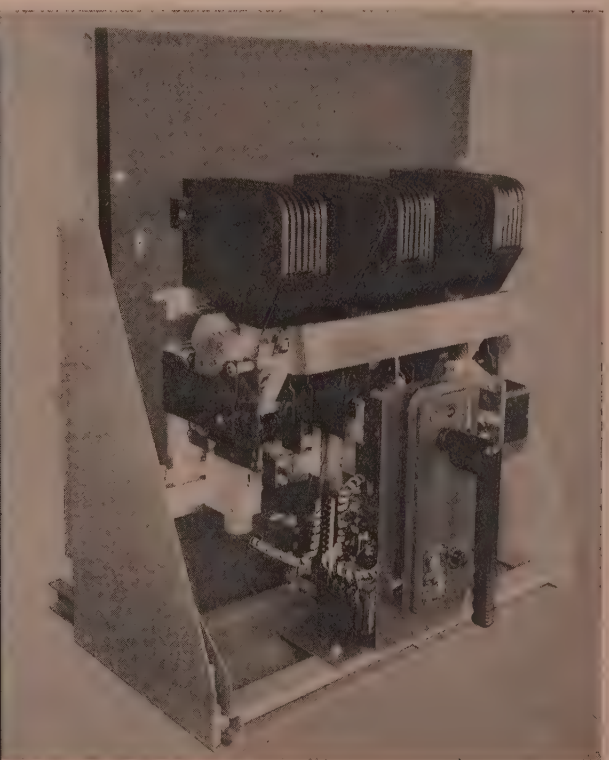
Channel Master Aluminum EMT can be purchased through your regular distributor. Ask him to show you how to make faster, better installations at lower cost.

CHANNEL MASTER CORP. ELLENVILLE. NEW YORK

MEARS
circuit breakers meet every requirement

for reliability
economy
adaptability
performance

On the drawing board, in exhaustive development tests, in rugged industrial use, Mears Circuit Breakers stand up to the most rigid requirements of design and performance. Manufactured by an independent company whose primary concern is the production of a superior circuit breaker, the Mears line offers flexibility and quality which are unsurpassed. When you see the big "M" on a circuit breaker, you know *this* breaker will outlast the equipment it serves!



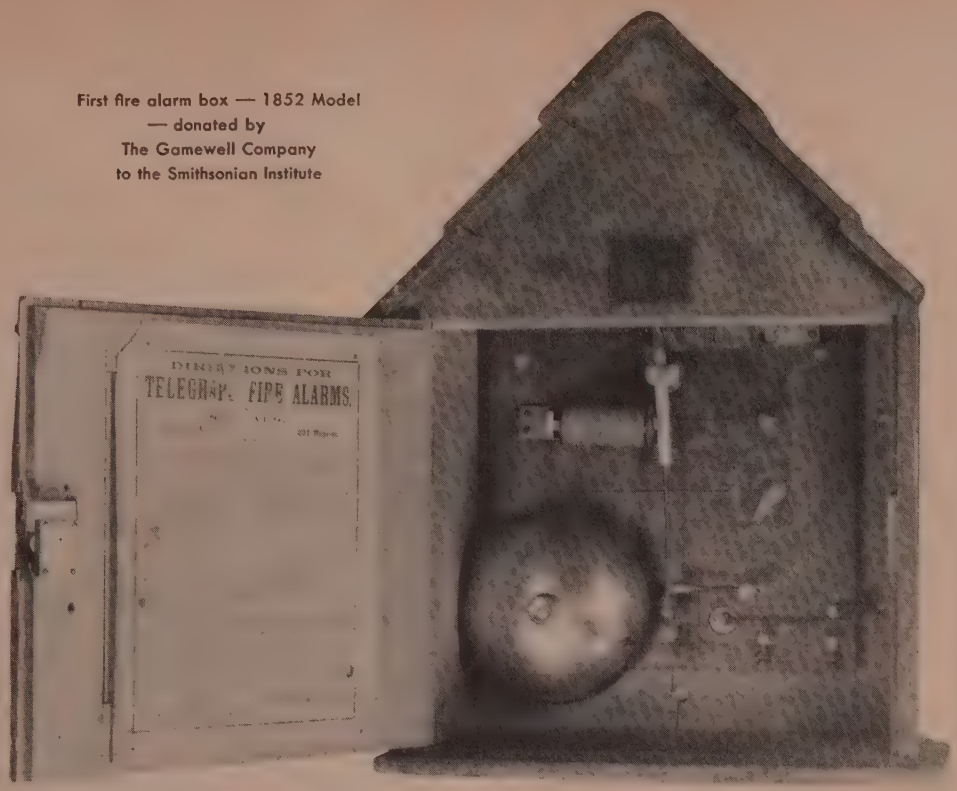
INDEPENDENT MANUFACTURERS OF AIR AND FUSED CIRCUIT BREAKERS IN THE 600-6000 AMP. RANGE

Write for new catalog to

MEARS ELECTRIC CIRCUIT BREAKERS, INC.

P. O. Box 3798, Portland 8, Oregon

First fire alarm box — 1852 Model — donated by The Gamewell Company to the Smithsonian Institute

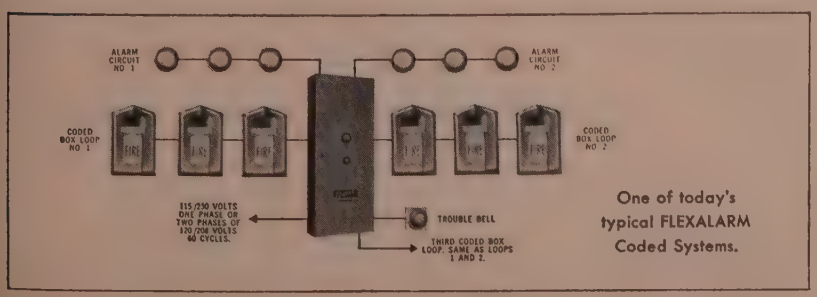


A century of positive protection . . .

More than a hundred years ago, the wooden, hand-cranked Gamewell Fire Alarm box shown above was the most dependable fire alarm device of its day. And, during the years since then, Gamewell has consistently pioneered in the manufacture of emergency signaling systems . . . with thousands of municipal and industrial systems in daily service.

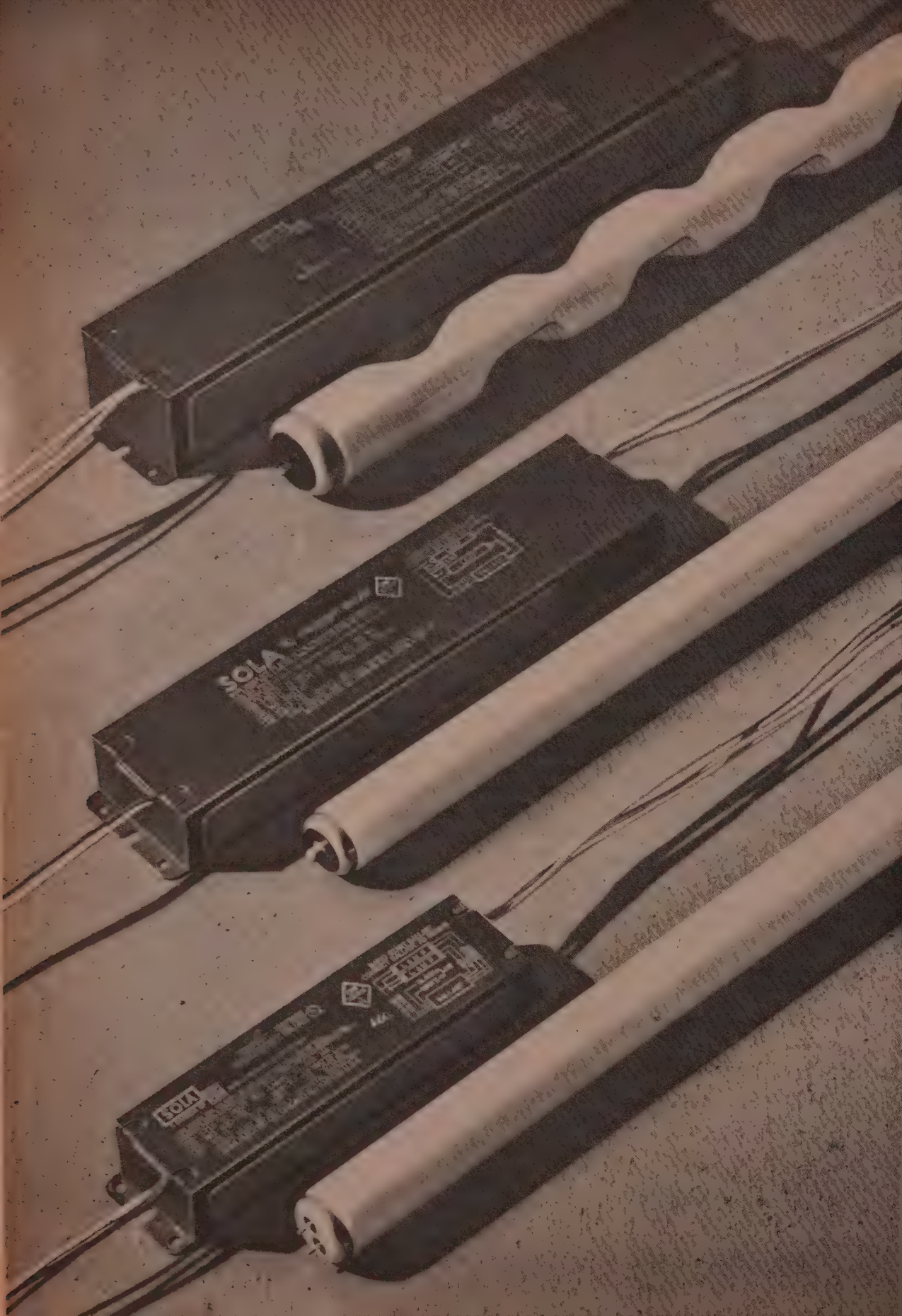
That's the performance record you can depend on when you specify today's modern, highly automated Gamewell industrial FLEXALARM system like that shown below. Such systems are pre-engineered to meet the precise needs of any plant. FLEXALARM systems are available with unlimited variations. They provide automatic fire detection devices, sensing fire in its incipient stages . . . with optional direct and automatic connections to municipal and other central fire stations. Connected to sprinkler systems, FLEXALARM systems automatically transmit an alarm on water-flow preventing loss from fire and water damage. These systems provide *complete* coverage.

Gamewell is happy to assist the consulting engineer and electrical contractor with emergency signaling systems for any property. For maximum protection at minimum cost, specify Gamewell on your next project. For details write THE GAMEWELL COMPANY, 1317 Chestnut Street, Newton Upper Falls 64, Massachusetts.



One of today's typical FLEXALARM Coded Systems.

Gamewell®
FIRST...WHEN SECONDS COUNT


SOLA
SOLA

Sola Ballast Catalog Number 670-130
for two 96-inch or 72-inch 1500ma rapid start lamps

Sola Ballast Catalog Number 650-110
for two F96T21 or two F72T12 425ma slimline lamps

Sola Ballast Catalog Number 670-109
for two F40T12 430ma rapid start lamps

Cool thinking results in family of Sola "upside-down" fluorescent ballasts

One of the major problems in modern fluorescent lighting is the problem of ballast heating in an operating fixture. Well ahead of other major ballast manufacturers, Sola engineers started thinking cool and designing cool in terms of in-fixture ballast performance.

Here's the latest of their new ideas in ballasts—the components are mounted *upside down* in the case. The fiber insulator is removed from its conventional position on the mounting surface and put beneath the label surface where it can't trap heat inside the ballast case.

The new design permits normal core and coil heat to be quickly conducted away by the fixture housing and also puts extra space between the capacitor and the core and coil to extend capacitor life. The result is a ballast that works more efficiently, lasts longer, and provides full light output over its rated life—premium performance at no extra cost, proved by repeated in-fixture ballast testing.

Now three Sola ballasts with upside-down insides are available. Manufacturers of quality lighting fixtures, as well as specifiers and users, have been quick to recognize the good sense of the idea—just as they were with other Sola innovations such as the constant-wattage circuit and the series-sequence circuit which are now industry standards.

The cool thinking that resulted in these new ballasts is typical of Sola's comprehensive engineering approach in designing quality products. At Sola, it goes on all the time. Look to Sola when you want ballasts that will help quality fluorescent fixtures deliver all the light that's engineered into their lamps . . . that will give coolest possible in-fixture performance . . . that will live up to their own rated life.

Consult your Sola lighting representative for complete information on Sola products—request literature on "upside down" ballasts.

Write for Bulletin 26D-FL.

SOLA

B P C

Sola Manufactures: Constant Voltage Transformers, Regulated DC Power Supplies, Constant Wattage Mercury Lamp Transformers and Fluorescent Lamp Ballasts

SOLA ELECTRIC CO. A Division of Basic Products Corporation

4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414 • In Canada, Sola Electric (Canada) Ltd., 377 Evans Avenue, Toronto 18, Ontario

Your cheapest insurance against sudden darkness

When the lights go out, Exide Lightguard® goes on automatically. It protects you from panic, damage and pilferage when power sources are interrupted. Plugs into a regular outlet—charges itself automatically—provides light when you need it the most.

Exide Lightguard comes in three different models designed to your needs. Be protected—write for full details. Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

Exide®

NEW DRAW-OUT DESIGN
LIMITAMP* MOTOR CONTROL

INTERRUPTS IN ½ CYCLE

. . . protection when you need it—with Limitamp control

Rated 2300- to 4600-volts for a-c motors up to 3000 hp.

Here is performance you can count on . . . to start, stop and protect your motor under *your* environmental conditions!

General Electric's new draw-out Limitamp control is designed to interrupt in the first ½ cycle. Current is limited in the first ¼ cycle. EJ-2 fuses—the standard of excellence—give you this dependable short-circuit protection.

The new draw-out contactor is designed to give outstanding performance under all conditions of load—from small motors running light to large motors at "locked rotor." This improved performance comes from a new blow-out structure and an improved arc chute with superior extinguishing action.

The new contactor also meets a 60-kv base impulse level. Performance of the entire design has been exhaustively tested in General Electric's high-voltage laboratories . . . and, complete design coordination of bus, cable, current transformers, contactors, fuses, insulators and overload relays means top protection for men and equipment!

Ask your G-E Apparatus Sales Engineer or Agent about other advanced-design performance, maintenance, installation and operation features of new Limitamp control. Or, write Sect. 783-12, General Electric Co., Schenectady, N. Y. for Bulletin GEA-6893. Industry Control Dept., Salem, Va.

Progress Is Our Most Important Product

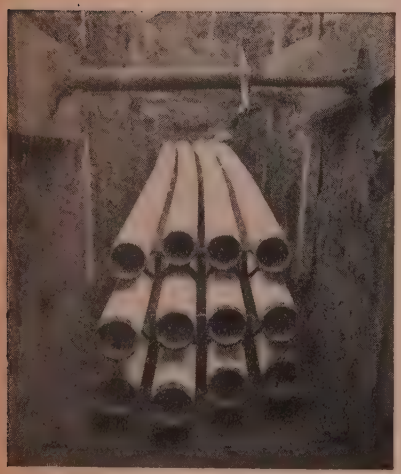
GENERAL ELECTRIC

* Reg. Trade-mark of General Electric Company

Get peak cable protection ***at lowest dollar cost***

Transite Ducts can be laid directly in trench without concrete envelope. Or if ductbank is to be concrete enclosed—thinner walled Transite Duct may be used. In all other respects both heavy-wall and thin-wall Transite Ducts are identical.

Transite Ducts save on the job and after!



No other duct material gives you so many installation and in-service economies

In every way, Transite® Ducts are the most efficient electrical ducts you can install. And—when assembled with J-M's Plastic Coupling—their cost is remarkably low!

One reason for this economy is in installation. Strong, lightweight, long—Transite lengths are easy to handle and install . . . Your men set the ducts in place easily, join them tightly in seconds. Transite's smooth bore is free of burrs and obstructions. Thus, long cable pulls are easily accomplished with no damage to cable sheathing.

You see another reason for Transite's economy in performance. Once in service, Transite's unusually high rate of heat dissipation means cables run cooler, last longer. Transite also confines arc damage . . . cannot burn, smoke or fume. It won't generate explosive or toxic gases. If arcing does occur, Transite Ducts won't sag or adhere to cable.

Let us send the Transite Duct brochure EL-29A. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

Angel Falls in Venezuela is the highest in the world, drops 3,212 feet. Surrounded by tangled, steaming jungle, it remained undiscovered until 1935 when James Angel, an American aviator hunting for gold, sighted the falls from his plane. It is 12 times higher than Niagara Falls.

ONLY ONE HIGHEST

BRONCO Certified 66 NEOPRENE

PORTABLE ELECTRICAL CORD AND CABLE

has the HIGHEST NEOPRENE content in the industry

At no extra cost you get the supreme protection provided by an outer jacket containing 67.32% Neoprene. It is certified by a Registered Professional Engineer to contain not less than this amount. In steaming jungle, Arctic wasteland, or American factory, Bronco 66 Certified reaches new heights of dependability and length of service-life. Bronco 66 Certified is a great cable in every respect. Buna rubber insulation is built to exceed ASTM D-755 test requirements. Jacket and insulation are Synchro-Cured, the Bronco process of vulcanization which brings all polymers to optimum cure and results in unequalled flex-life. Self-measuring jacket is branded every two feet exactly by a patented Bronco process — U. S. patent No. 2867001. Complete identification is molded into the jacket so it will not rub off.

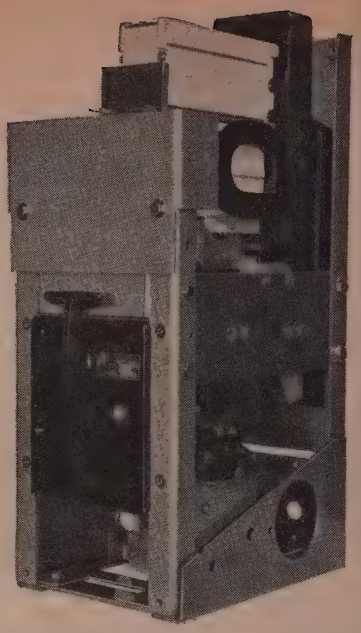
ALWAYS SPECIFY BRONCO 66 CERTIFIED and enjoy the long term economy of top quality.

WESTERN

SEND FOR FREE CATALOG

WESTERN INSULATED WIRE COMPANY
Los Angeles 58, California

The d-c breaker you can buy today that won't be obsolete tomorrow



Stationary type single-pole FB breaker in 1200 amp rating with manual stored energy closing.

Actually this new-design model FB circuit breaker from I-T-E is somewhat of a phenomenon in its field. Of all breakers available for direct current, this is the only one that really makes use of today's modern materials and up-to-date knowledge of circuit breaker design. You might say it's the only modern d-c circuit breaker on the market today.

HIGH SPEED

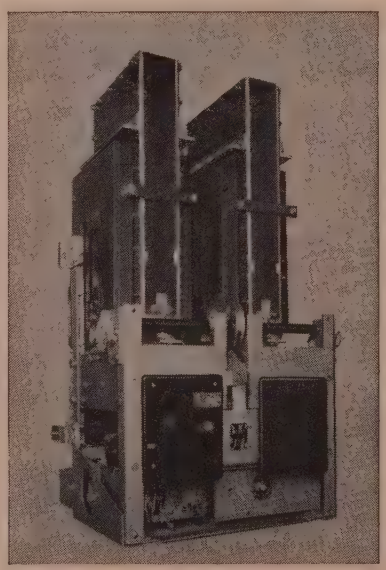
In today's high-capacity d-c circuits, you *need* a high-speed breaker. Otherwise you risk thermal or mechanical damage to equipment—such troubles as commutator flashover in rotating equipment or arc-back damage to your rectifiers. Many circuits today still have semi-high-speed breakers that don't give adequate protection. At the time they were installed they may have been the best available. Or else high-speed breakers were too expensive. That isn't true with the FB. Without paying a premium price, you get high-speed operation. Current limiting action occurs *within 6 milliseconds*. And the breaker may be safely applied to 1000 volt d-c circuits having a rate of rise of 15 million amperes per second. So the FB breaker can be used with confidence in practically all d-c circuits.

COMPACT SIZE AND LIGHT WEIGHT

Probably the most obvious difference between the new FB breaker and some of the old-design models still being sold is the greater compactness. This is one of the direct results of modern materials and technology. I-T-E engineers have given you actually superior circuit protection in less space. And the use of modern materials has shaved off many pounds of weight. Because of this they are now available in general-purpose enclosures. In addition, such new-design details as tilting arc chutes, elimination of flexible connectors, and exclusive drawout construction make this the easiest-to-maintain d-c circuit breaker you ever saw.

AVAILABLE IN 1 OR 2 POLES

If you are operating a single-wire grounded system, a single-pole circuit breaker arrangement will suffice. But suppose you are operating a 2-wire, ungrounded system. Then a 2-pole circuit breaker is desirable. And only the I-T-E model FB offers it. This is real 2-pole construction, with both poles fully integrated mechanically and electrically for simultaneous opening and closing under all conditions.



Drawout type 2-pole breaker in 6000 amp rating, electrically operated.

REALLY FUNCTIONAL MECHANICAL ADVANCES

Who but I-T-E would be first to give you an advance such as manual stored energy closing in a d-c circuit breaker? No slow burning of contacts with the FB. It closes in roughly 1/12 to 1/6 second for greater safety and longer contact life. You have your choice of either manual or electrical closing. The motor-operated closing mechanism draws only 5 amperes—a great advantage over the usual 50 amperes required by solenoids. Precision construction typical of I-T-E equipment, coupled with drawout design, permits complete interchangeability of breakers and parts in breakers of equal rating.

REPLACE NOW

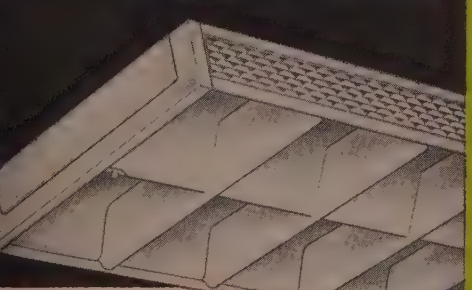
There's questionable economy in trying to stretch out the life of old equipment that can mean costly downtime and inadequate protection. The wiser move is to replace now with new-design model FB breakers that are far ahead of the field. Models in capacities from 1200 through 12,000 amperes continuous and 1000 volts d-c. Write for the new detailed and illustrated Bulletin 4601-1A. I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

ow Available for
160 SCHOOL PROJECTS
- New Construction
- Renovation

THE LEXINGTON

lew Improved RICHMOND nd LEXINGTON ..at New Low Prices



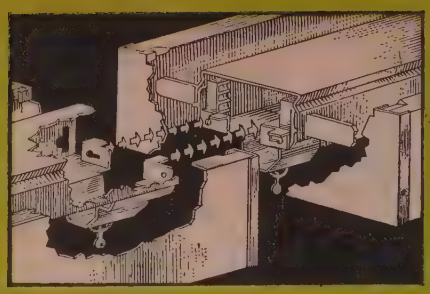
THE RICHMOND

The newly Improved Richmond and exington Series by Miller offer outtanding Values for lighting Schools, ffices, and Stores.

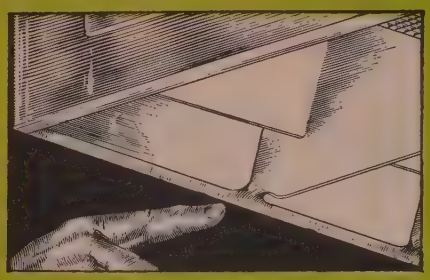
Four exclusive *installation and maintnance features* have been built into ll units in both series. *Prices for most ypes are at new lows,* while illumination performance remains high as ever. rimmer, more modern appearance is nother plus.

You can choose between 45° x 45° r 35° x 25° shielding for both series; or 4 Lp., in 4 or 8 foot lengths. *lower-Groove* operation is a brand new ption for the 2 Lp. Richmond.

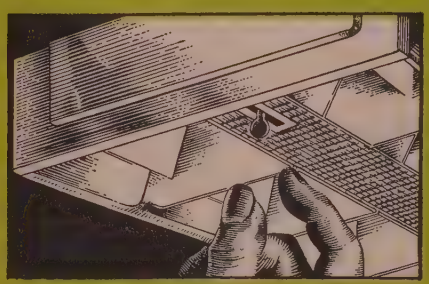
For complete catalog information ail coupon or write Dept. RL 460. or a physical demonstration contact our Miller Representative, or your Miller Distributor.



Sure Alignment . . . Built-in Connector



Rigid, Rattle-free Shielding Assembly



Sure Locking, Visual Action Latches

Easily Relamped from Single Ladder Position

MAIL TODAY

To: Dept. RL-460
THE MILLER COMPANY, Meriden, Conn.

- ☐ I'd like additional information about The New, Improved RICHMOND & LEXINGTON Lighting Fixtures.
- ☐ Have Your Field Representative contact me.

Name.....Position.....

Company.....

Street.....

City.....State.....

LIGHTING BY miller SINCE 1844

THE miller COMPANY
MERIDEN, CONNECTICUT • UTICA, OHI

FULL-VALUE
CERTIFIED
TRANSFORMER
GENERAL ELECTRIC

- Superior design, features, and performance
- Faster shipment
- Complete service

14% lighter;

SYMBOL OF FULL VALUE

With this seal, General Electric certifies full value for your transformer dollar; full value in terms of superior basic design, features, and performance . . . plus faster order handling and shipment . . plus complete service before, during, and after installation. No other transformer manufacturer can match this complete General Electric package.

easier to install, maintain

General Electric dry-type transformers feature all-aluminum conductors, low sound levels, and superior insulation

Easier installation . . . safer, quieter operation . . . less maintenance . . . and longer life . . . all are features of General Electric's lighter full-value dry-type transformers.

Use of aluminum for all current-carrying parts has reduced weight up to *14 percent over previous designs!* This means simplified installation on roofs, catwalks, and other overhead locations. Sound levels meet or are lower than published standards. Transformers last far longer with exclusive Alpholite* insulation and added reliability is made possible by the higher impulse levels listed below:

Voltage Class (KV)	Impulse Levels (KV)
1.2	10
2.5	20
5.0	25
8.6	65
15.0	65

These important time- and money-saving features are yours with *every* General Electric dry-type transformer—open and sealed.

Minimum Maintenance

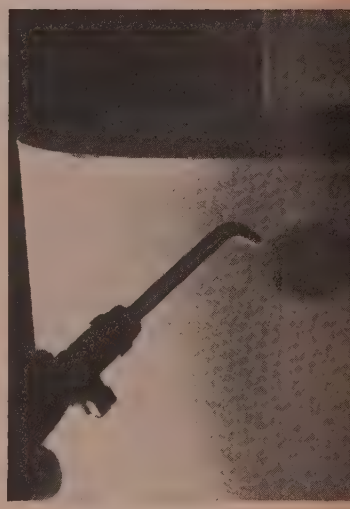
Maintenance is minimized with G-E dry-type transformers. Open-dry units—for indoor use—require only periodic cleaning of core and coil structure. Sealed units—ideal for dusty, dirty, or other contaminated atmospheres—need only an occasional exterior painting.

For information on full-value transformers, contact your G-E Apparatus Sales Engineer or Agent today. Write for GEA-6668 and GEA-5790. General Electric Co., Schenectady, N. Y.

416-28

* Trade-mark of General Electric Company.

ALUMINUM CONDUCTORS in General Electric dry-type units reduce weight up to 14%.



ALPHOLITE INSULATION provides high dielectric barrier between windings.

GENERAL ELECTRIC'S FULL LINE of transformers includes sealed (left) and open-dry types, 300 kva and above.

Progress Is Our Most Important Product

GENERAL ELECTRIC

On this tough flexing job . . .

New General Electric TenX Cord lasts 600% longer

Packing bottles of beer certainly isn't the most common job for a heavy-duty cord . . . but you may need a cord that will stand up under the same kind of continued bending and flexing.

The machine on which G-E TenX* racked up this remarkable record — 600% longer service life — is in one of Milwaukee's leading breweries. Sixteen thousand times a day the cord on their machines cycle back and forth packaging beer in cartons. With every cycle, the cord bends and whips in a rugged endurance test.

Until three years ago, the plant's maintenance manager was pleased if a cord lasted two months in this service. Then General Electric offered TenX as part of an extensive in-use premarket test of this new product. The manager found that TenX lasted more than a year—more than six times longer than the best competitive product! Now he uses TenX on all sixteen machines.

This is the kind of service you, too, can expect when you use TenX Type SO heavy-duty cord. Use it indoors or outdoors—on stationary equipment or for trailing and portable equipment and tools.

Here are some of the "reasons why" TenX cord has superior built-in resistance to every one of the ten commonest causes of cord failures: abrasion, acids, alkalies, crushing, flame, grease, impact, mechanical damage, moisture, and oils.

Conductor—rope-stranded, high-tensile copper alloy, flexible to begin with, drawn into more and finer-than-average strands to combine high-tensile strength with long-term capacity for continuous twisting and flexing. In actual use at the brewery, TenX was never replaced due to conductor breakage.

Lead-cured neoprene jacket for protection against abrasion, oil, water, etc., and reinforced with a basket-weave braid for added jacket strength.

Insulation — rubber, for complete protection against moisture, and color-coded for easy circuit identification.

TenX is available at all G-E wire and cable distributors in 2, 3, and 4 conductors in No. 18 through No. 10 Awg. Sizes No. 14 and larger carry the P-108-BM (Bureau of Mines) marking clearly embossed on the jacket. This cord is listed by Underwriters' Laboratories, Inc., and exceeds ASTM D 752 (neoprene) Specifications and IPCEA S-19-81 Standards.

**Trade-mark General Electric Company.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

For more information about TenX, fill in and mail this coupon.

General Electric Company
Wire and Cable Department, Section W250-418
Bridgeport 2, Connecticut

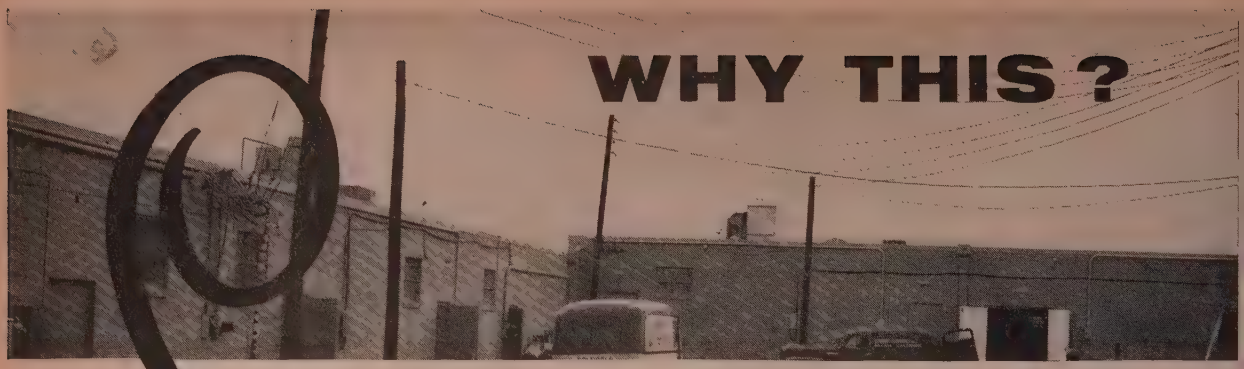
Please send me the leaflet on new TenX lead-cured Type SO heavy-duty flexible cord.

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____



WHY NOT THIS?

Why let a maze of wires detract from the attractive exterior of the modern industrial plant or commercial structure? Why not specify Cope Wireway and eliminate utility poles and cables as project engineers were able to do above. Cope Wireway is strong, functionally attractive, completely weatherproof—ideal for *outdoor* as well as indoor installations.

And most important, it *saves* you money! A *single* 24″ wide section of Cope Wireway supports as many cables as *sixteen* lengths of 4″ conduit—thus reducing material and installation costs.

Cope's complete line of elbows, tees and other fittings provides necessary system *flexibility* even in cramped quarters . . . allows for changes in direction or elevation.

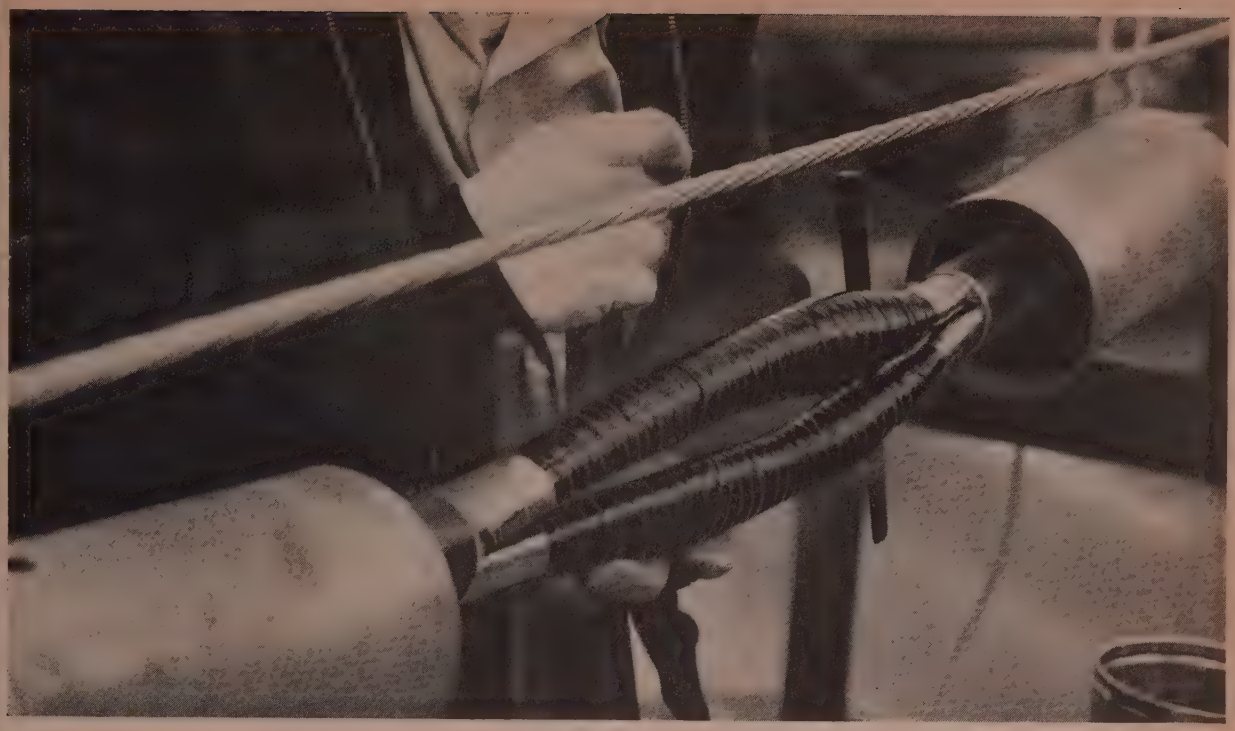
In Cope Wireway, cable is always accessible . . . for routine maintenance checks or later re-routing or additions to your present electrical distribution system.

Learn why there is a *difference* with Cope Cable Supports . . . available in aluminum or galvanized steel. Talk to your *authorized* Cope Electrical Wholesaler or write us direct and *ask for proof!*

1101

COPE

Originators of the first integrated line of Cable Supporting Systems
• WIREWAY • CHANNEL • LADDER • CONTROLWAY
Division of ROME CABLE CORPORATION
COLLEGEVILLE, PENNSYLVANIA
Sold only through authorized electrical wholesalers



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Whether you're splicing transmission lines or residential outlets, every splice you make must be final, safe and *permanent*. You can't afford any tape but the *best* . . . and the best costs no more. SLIPKNOT PLASTIC ELECTRICAL TAPE is the choice of the country's most experienced electricians, because it *handles easily, conforms readily,* and *snugs* and *stays down.*

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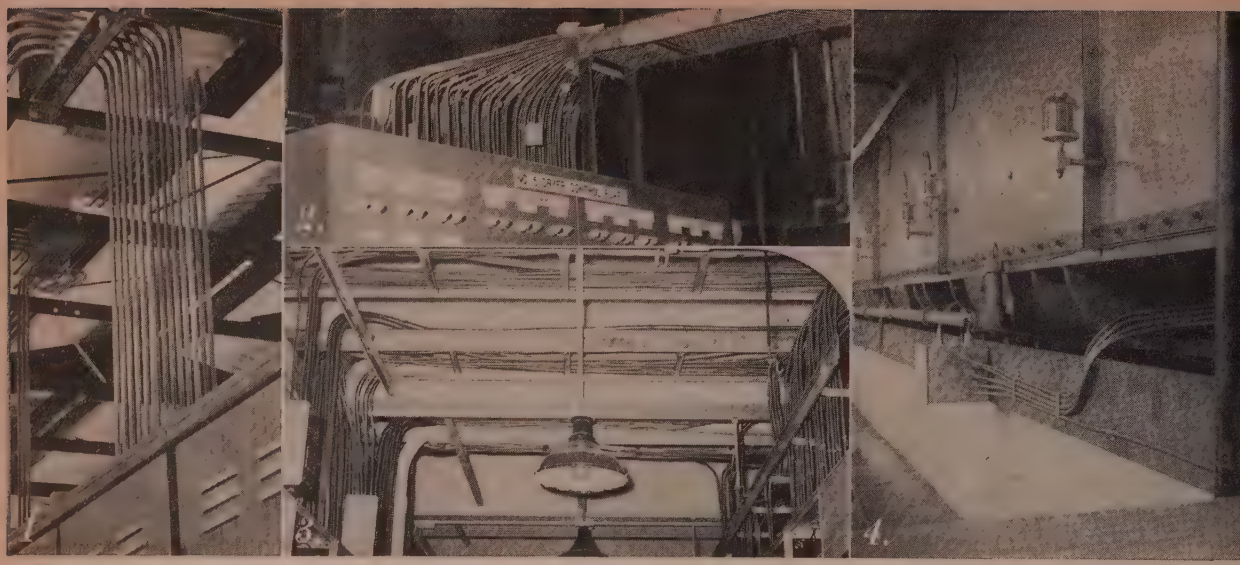

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performance and permanenc
Economical m.i. easily installe
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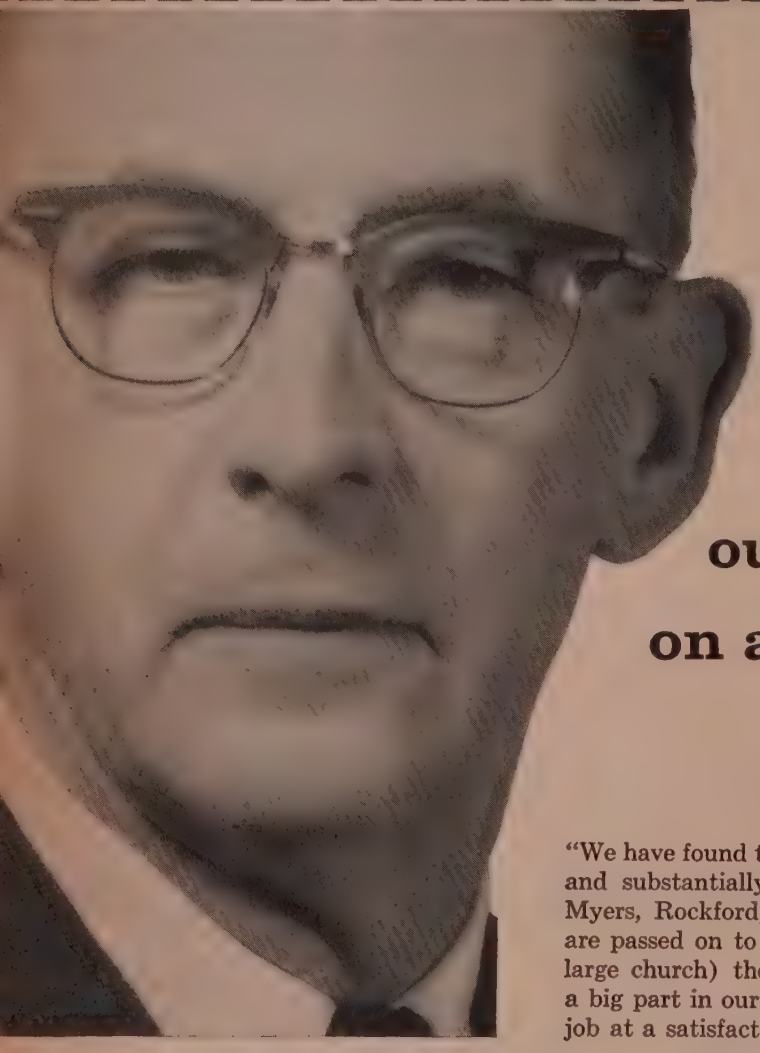
JOB-PROFIT TOOLING IDEAS

FROM GREENLEE



"Greenlee tools helped us streamline our operations and outbid competition on a tough contract"

says Mr. Art Myers, owner

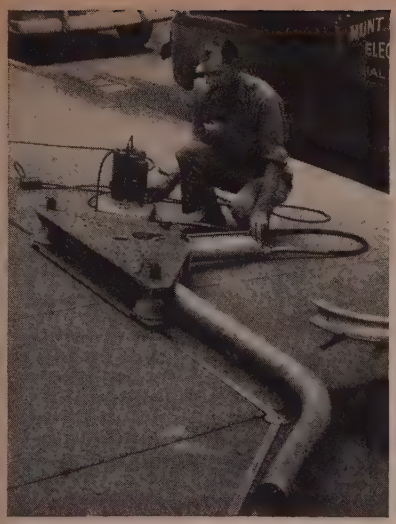
MYERS ELECTRIC

"We have found that Greenlee tools mechanize much of our work and substantially reduce labor and material costs," says Art Myers, Rockford, Illinois, contractor. "The savings we realize are passed on to our customers. On this job (an addition to a large church) the increased efficiency of Greenlee tools played a big part in our getting the contract and being able to do the job at a satisfactory profit."

Art Myers went on to explain that the contract for the church addition posed many installation problems which could have run costs well over the bid figure. For example, 800-amp service had to be brought underground from a pole transformer located across a busy one-way street. Laying the conduit by old-fashioned methods meant trenching, laying the conduit, then filling and repaving.

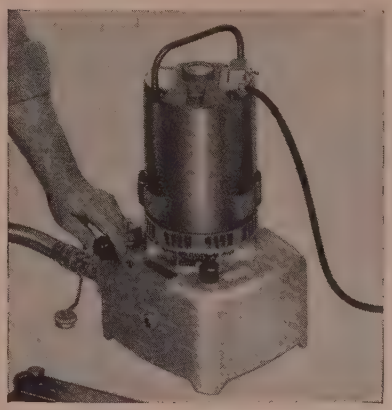
Myers solved this problem economically with a Greenlee No. 790 pipe pusher (right). The only digging necessary was a narrow trench for the pusher and a shallow ditch at the base of the utility pole. Pusher setup time was less than one hour . . . actual pushing time less than three hours for the complete job. Pushing the conduit underground, Myers reduced installation time 75% . . . and saved $500 by eliminating street repair costs.

Other time and cost savings made possible by Greenlee tools are outlined on facing page.

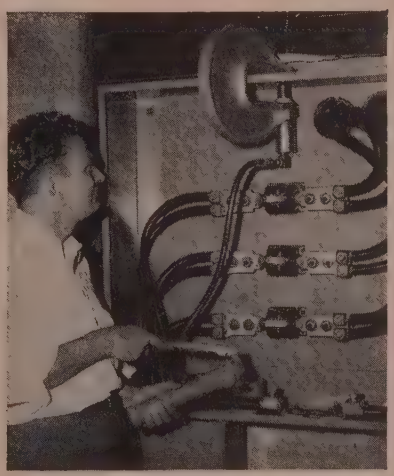


Idea for making accurate conduit bends on the job — Art Myers reports that his men make conduit bends and offsets more quickly and uniformly since a Greenlee No. 884 hydraulic conduit bender and a Greenlee No. 798 power pump were added to equipment inventory. Myers drives the No. 884 with a Greenlee No. 798 power pump. With this combination one man can bend 4" conduit 90 degrees in 4 minutes . . . with one setup, one shot. Also, bending offsets on the job rather than buying manufactured bends and fittings has reduced material costs and cut installation time. Offsets made on the Greenlee bender reduced the number of fittings and connections . . . simplified cable pulling. Greenlee lightweight hydraulic benders are available for ½" - 4" steel or aluminum conduit. Attachments available for bending E.M.T., bus bars, and tubing. All models are completely portable . . . one man can transport benders from job to job.

Idea for boosting operating speed on pipe pushers and benders — Myers has discovered — along with many contractors throughout the country — that converting from hand operations to Greenlee power pumps provides an additional time saving on nearly every job. To power the pipe pusher, Art Myers selected a Greenlee No. 797 hydraulic power pump to push pipe underground at 2 ft per minute. A Greenlee No. 798 high-pressure, two-speed hydraulic power pump was purchased to increase operating speed on their No. 884 bender and No. 1732 one-shot



knockout punch driver. Greenlee power pumps range in size from compact units like the No. 798 to the No. 797 that delivers up to 106 cu. in. per minute at 10,000 psi.



Idea for making conduit openings . . . in seconds — Greenlee one-shot knockout punch drivers prove real time- and money-savers when it comes to preparing distribution boxes for conduit. On the church addition, both the Greenlee No. 1731 (shown) and 1732 one-shot drivers were used. Fast, lightweight, and powerful, these compact drivers are set up and operated by one man. Punches cut through 10-gauge metal with a few strokes of the hydraulic pump . . . a power pump provides even faster operation. Two sizes: No. 1732 for punching ½" - 4" conduit holes; No. 1731 for ½", ¾", 1" conduit openings. Greenlee knockout punches are available for conduit from ½" - 5" . . . with wrench, ratchet, or hydraulic drive.

Idea for fast cable pulling — Getting electrical service into the church addition required pulling eight 500 MCM primary cables — four to a conduit — from a pole transformer, under the street, to a meter cabinet in the church basement. To speed this and other pulling jobs, Art Myers used a Greenlee No. 765 cable puller. This versatile puller clamps directly to exposed or concealed conduit . . . pulls from any angle or position with any needed force up to 7,500 pounds . . . without straining hangers or conduit.

To get complete information on GREENLEE JOB-PROFIT TOOLING write for fully illustrated, quick-reference Bulletin E-240.

GREENLEE TOOL CO. 1883 Columbia Avenue, Rockford, Illinois

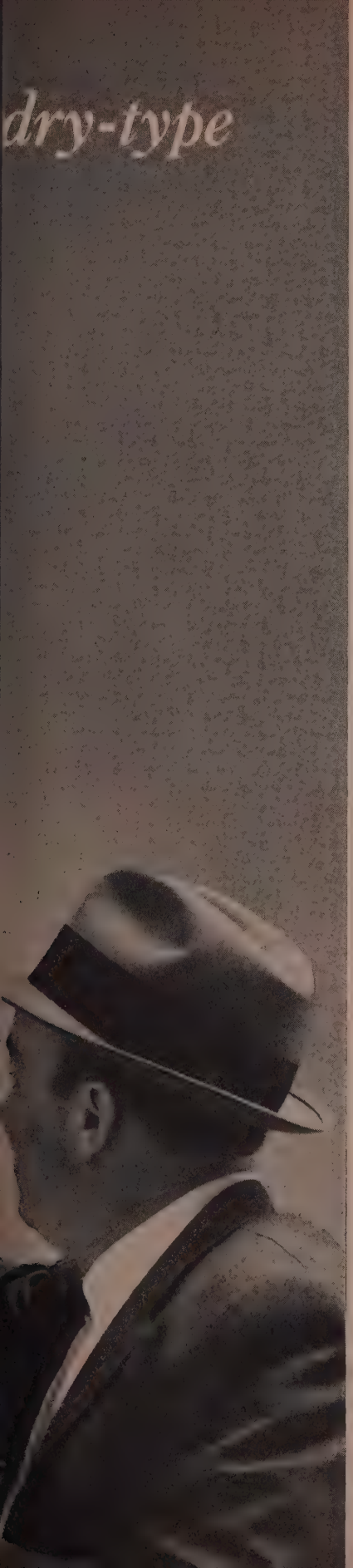
TOOLS FOR CRAFTSMEN

GREENLEE

JOB-PROFIT TOOLING

. . . cost control for contractors

"Hold it---I'll have this new



dry-type

ready in a second!"

You'll save time and money every time you install a new General Electric QHT dry-type transformer.*

QHT dry-type transformers give you, in every rating, in every application, a balanced combination of small size, lightweight, superior installation features, high-temperature insulation and quiet operation. This combination means easier installation and practically eliminates the major sources of dry-type transformer complaints, noise and insulation failure.

Installation is easy with the new dry-types because the units are built with convenient knock-outs, large terminal compartments and wiring spaces which are easily accessible from the front. Lifting provisions are made for units weighing more than 65 pounds. These new transformers can be located at the load which eliminates the need for long, costly low-voltage feeders. No vaults, barriers, or ventilating fans are required.

A new insulation system—QHT dry-types have silicone impregnated insulation, highly moisture resistant, with an inherent ability to withstand high operating temperatures. Combined with materials such as aluminum conductors and cold-rolled grain-oriented silicon steel, you get a smaller, lighter, quiet dry-type transformer designed for years of service.

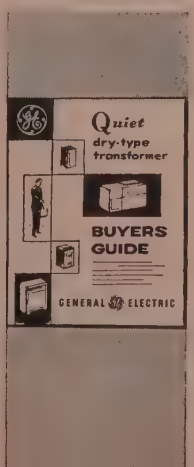
The new transformers are quiet—All have sound levels equal to or less than NEMA Standards. The rigid welded design of the units helps eliminate lamination vibrations, and on the larger units, built-in rubber mountings reduce noise transfer through conduits and mounting brackets.

Complete stocks of the new transformers are available at local electrical distributors. Single-phase units are built for applications through 167 kva and three-phase ratings are available up to and including 500 kva.

It will pay you to investigate how you can save on installation costs, get customer satisfaction, and be competitive, with General Electric's complete new line of quiet QHT dry-type transformers. Section 411-8, General Electric Company, Schenectady 5, New York.

*Quiet, High Temperature dry-type transformers.

GENERAL ELECTRIC



SECTION C411-8
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Please send me the new Buyers Guide, GEC-1047.

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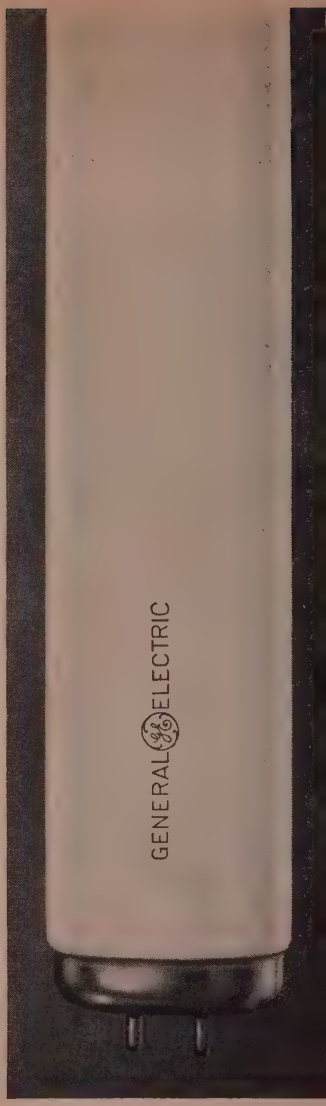


TWO QUESTIONS:

1. Who'll throw out the first baseball at Griffith Stadium in 1962?

2. How many fluorescent lamps (installed this month) will your customers throw out by opening day, 1962?

As for question number one, traditionally the President opens the baseball season in Washington by tossing out the first ball. Who he'll be, we don't know. Sorry!

But we *do* know something about question number two. If a customer installs General Electric Fluorescents this month, *about 99% of them will still be going strong when the 1962 season opens!* That's because G-E Lamps are built and tested to give far fewer early burnouts. Records show that, on the average, G-E Lamp users will have between 1-2% burnouts after two years of single shift, or daytime, service. So, there are fewer work interruptions, fewer expensive, one-at-a-time lamp replacements. And the lighting level stays higher, longer because of G-E improvements.

G-E Lamps can save your customers money. Whether they use 40-watt, high output or slimlines, there's a G-E Money Saver Lamp that's just right for the job. And even bigger savings if they install a new system with G-E Power Groove® Lamps—the most powerful fluorescent they can buy. Ask your G-E Lamp representative for expert lighting advice—or write: General Electric Co., Large Lamp Dept. C-017, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL ELECTRIC

General Electric . . . where bright ideas become better lamps

Soft Rubber Boots Prevent Injury to men or machines. A-B pendant stations are available with from 2 to 16 units, plus emergency stop unit in bottom of enclosure.

Allen-Bradley offers the

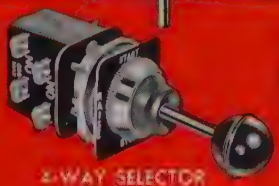
MOST COMPLETE LINE

of oiltight heavy-duty

CONTROL UNITS

The wide selection of Allen-Bradley Bulletin 800T push buttons and control units will enable you to satisfy each and every control station requirement. A-B control units and stations have seals to exclude oils and cutting fluids—contacts cannot become fouled. And *all* control units have the popular A-B double break, silver contacts that assure reliable operation—without maintenance. The rugged construction, flexibility, and generous wiring room of Allen-Bradley's Bulletin 800T line are "bonus" features. To get the best in every way—insist on Allen-Bradley. Send for Publication 6090, today.

ILLUMINATED PUSH BUTTON
Space-saving two-in-one control unit.

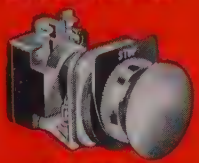


2-WAY SELECTOR SWITCH
Can also be furnished for 2-way operation.

ENCAPSULATED PILOT LIGHT
Transformer type for rugged 6-volt bulb.

PUSH-TO-TEST
Six different color lenses available.

SELECTOR SWITCH
With coin slot operator. Other operators available.



TIME DELAY
Delay adjustable from 0.5 to 5 seconds.

POTENTIOMETER UNIT
Furnished in 2- or 3-watt capacity ratings.

LOCK TYPE
For selector switch or push button operation.

DOUBLE CIRCUIT
Has 2 N.O. or 2 N.C. sets of contacts.

16 UNIT STATION
A die-cast aluminum enclosure. Sheet metal cabinets also available for up to 25 control units.

6-40-BM

ALLEN-BRADLEY

Member of NEMA

QUALITY MOTOR CONTROL

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

Yes, Allen-Bradley also makes...

A-B QUALITY

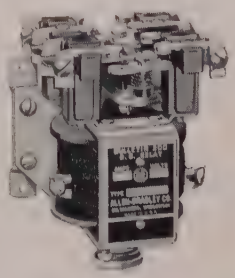
DC Contactors

Here's the only line of DC contactors using the simple solenoid design—with ONE moving part—in all ratings through Size 4. And their double break, silver alloy contacts never need servicing.

BULLETIN 202

DC Control Relays

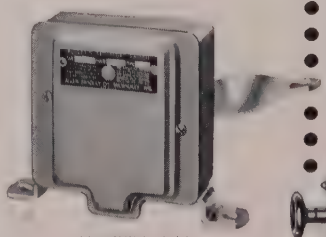
These relays are the counterpart of the Bulletin 700 line of AC relays—of which millions are in service. With only ONE moving part—these relays provide the ultimate in long life and reliability. Like the AC line, they have double break, silver contacts that never need maintenance. Made in a variety of types and with up to 8 switching poles.



BULLETIN 200

Float Switches

This versatile line of float switches is available in a wide range of types and enclosures to handle practically every industrial pumping job. They all feature a snap-action switch mechanism for positive operation no matter how slowly the liquid level changes.

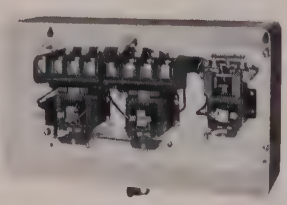


BULLETIN 840

BULLETIN 1209

Loom Switch

Manual starting switches designed for textile loom service. Design of operating lever makes accidental operation impossible. Lint-tight enclosure eliminates fire hazard.



BULLETIN 1270

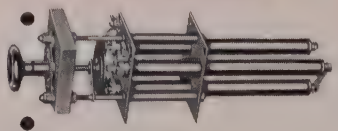
Automatic Transfer Switches

For use where power must be maintained, these panels automatically transfer the load to an auxiliary supply when normal supply fails or falls too low. Transfers automatically when the normal power supply is resumed. Mechanically interlocked.

BULLETIN 1232

Pump Control Panels

Designed for irrigation and oil field pumping applications. Can also be used with outdoor lighting systems. Uses standard A-B Bulletin 709 solenoid starter with manual disconnect switch or circuit breaker in weatherproof enclosure. Available with many optional features.



BULLETIN 410

AC and DC Rheostats

Provide absolutely stepless control over a wide resistance range. Full wattage capacity available at all settings. Sizes to 5400 watts.

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Quality **Motor Control**

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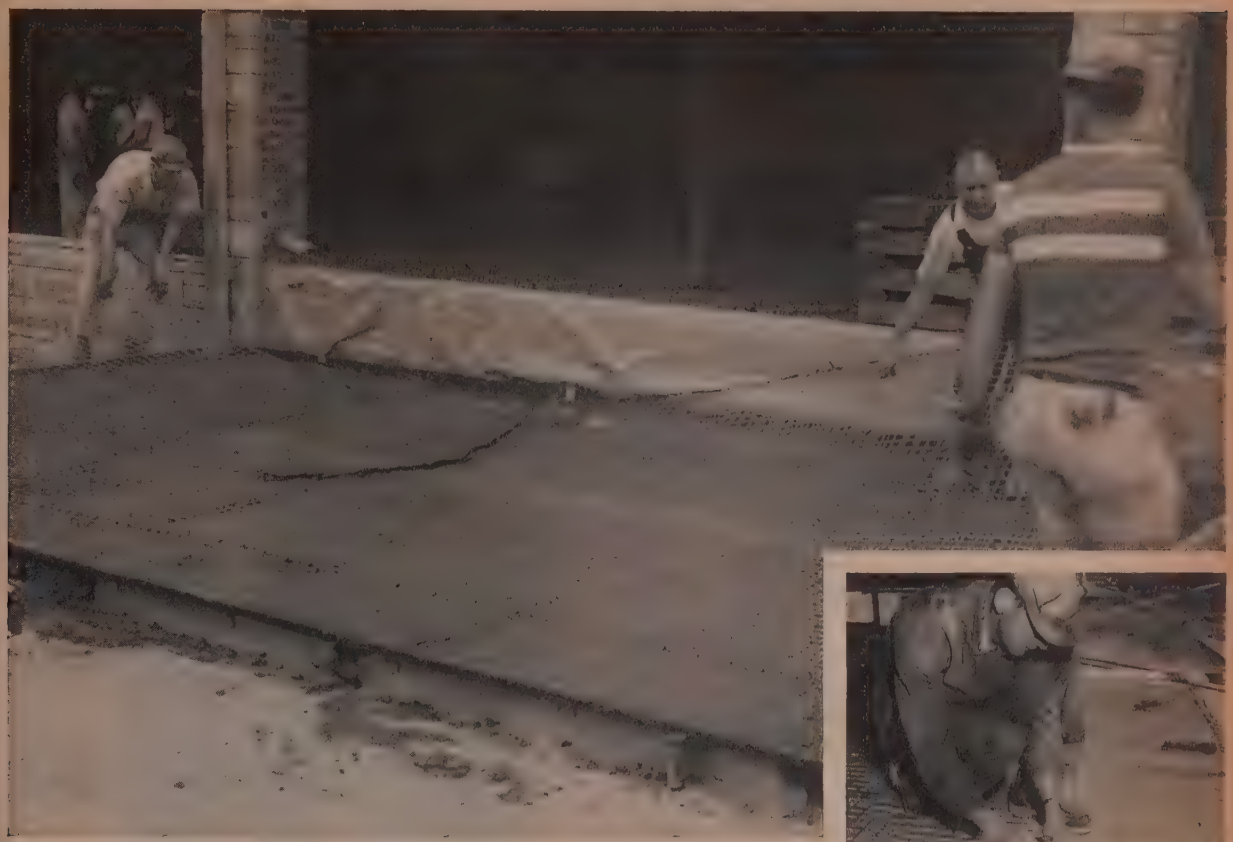
Another new development using

B.F.Goodrich Chemical *raw materials*



"Thermwire" Heating Cable insulated with Geon for melting snow on paved surfaces or on roofs is manufactured by Edwin L. Wiegand Co., Pittsburgh. B.F.Goodrich Chemical supplies the Geon vinyl used in compounding this insulation.

Bury Geon-insulated cable by taping to reinforcing wire in concrete

Snow shoveling won't be a problem for these shopping center sidewalks. Heating cable insulated with Geon vinyl is buried in the concrete. 190-foot lengths of cable are taped to the reinforcing wire rolled out between pourings. After the top ¾" layer of concrete is poured, the installation will be a permanent, load-building work saver.

Insulation made from Geon is especially useful for a buried-in-concrete installation because of its unusual resistance to abrasion, aging and most causes of corrosion. Other materials that were tried got brittle with heat—not Geon: it retains its excellent dielectric properties and flexibility.

Here's another way new applications are being developed through use of Geon vinyl. For more information, write Dept. GY-2, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Geon VINYLS

B.F.Goodrich Chemical Company
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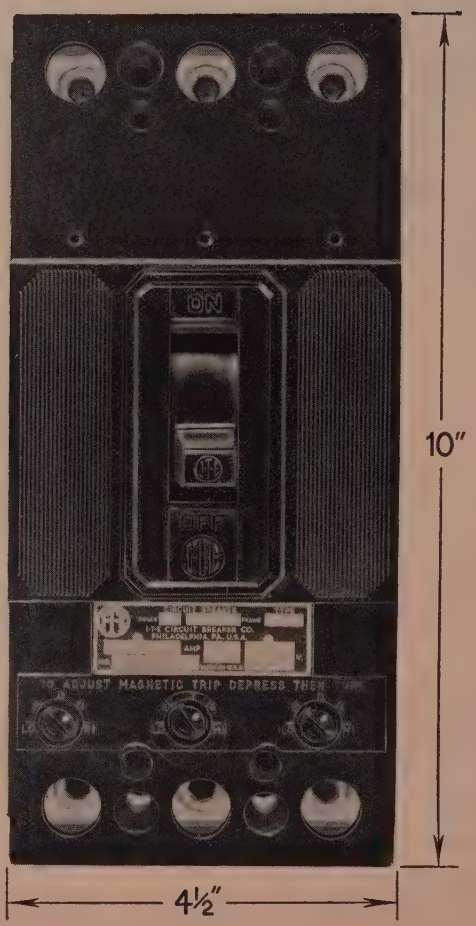
LOOK, EVERYBODY, NOW I'M 54% SMALLER



225 amp breaker in new FJ frame size. 70 to 225 amp continuous at 600 v, 2 or 3 poles. Interrupts 25,000 amp at 240 v, 15,000 amp at 600 v. Instantaneous trip adjustable externally.

Get all the details. Write today to I-T-E Circuit Breaker Company, Dept. SA, 1900 Hamilton St., Philadelphia 30, Pa.

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9TH YEAR • APRIL, 1960

ELECTRICAL CONSTRUCTION AND MAINTENANCE

Electric Heat—A Smash Hit

When the official statistics of the National Electric House Heating Symposium and Exhibition sponsored by NEMA last month are released, we hope they will be studied thoughtfully by industry leaders everywhere. What happened in Chicago is of profound significance to the whole electrical industry. The most optimistic attendance forecasts fell far short of the actual numbers that poured in from 48 states and several foreign countries.

At the mid-point of the meeting the preliminary registration count exceeded 2000. The usually ample convention facilities of the Sherman Hotel were nearly swamped by what veteran observers agreed was one of the largest and most seriously attentive audiences ever assembled in the electrical industry.

Up until a short time ago the hard-working, dedicated people who were carrying most of the burden of national missionary work in electric space heating could have convened comfortably in a hotel room. Their efforts encountered everything from cautious interest to outright hostility in the front offices of utilities until summer load growth began to shake up traditional attitudes. But one of their toughest problems was the solid wall of industry indifference and ignorance they had to break through.

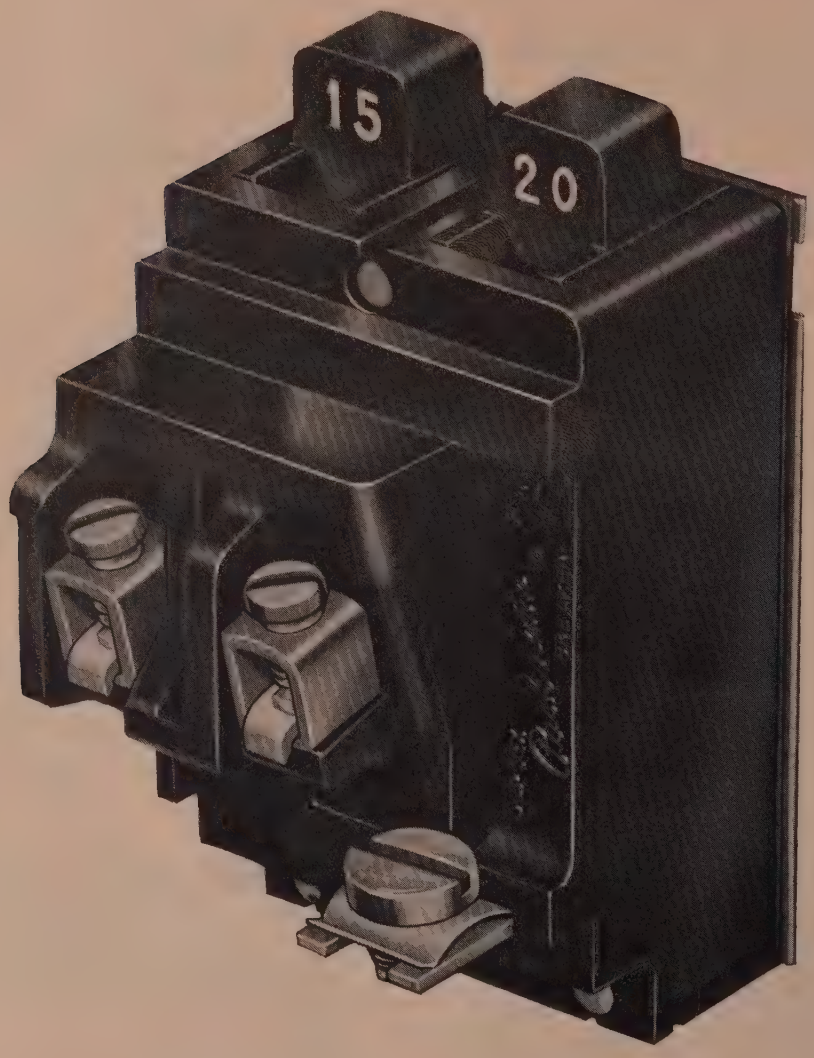
The smash turnout at a conference devoted exclusively to electric heat is tangible evidence that industry indifference is rapidly evaporating. The delegates came from all branches. And ignorance is no longer excusable. Accurate, authoritative information on electric space heating is now too readily available. Consumer and industry experience with more than 600,000 actual home installations is on the record.

A hard core of confident knowledge was formed in Chicago. It is now dispersed over the country. These people are going home with renewed enthusiasm, stiffer backbones and a lot less patience with obsolete notions about electric heat. The architects, engineers and yes, even some electrical contractors, who have been casually dismissing electric heat as "impractical and too expensive" are in serious danger of having their technical competence openly challenged.

If any one lesson of particular importance can be drawn from the heating conference, it is this: electrical utilities, distributors and contractors are NOW in the heating business. Competent knowledge of electric heat application and installation is, for most, no longer optional. People are going to hear a lot about electric heat. They are going to want it. They have a right to expect their electrical industry contacts to be well informed on heating products, professionally competent in application, and eager and willing to provide economical installations of the best quality and performance.

Wm. T. Stuart

The shape of things to come from BullDog



Watch for the introduction of our new Duplex Pushmatic®
. . . another product for better electrical living!

BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY

ELECTRICAL CONSTRUCTION AND MAINTENANCE

Powering a Data Processing Center

An Expert Tells How

Details of design and construction for the unusual wiring methods used to power electronic data processing systems in one of the country's largest computer centers—as described by a specialist in this type of electrical design.

By Frank J. Aluisio, *Chief Electrical Engineer, Air Research Associates, New York, N. Y.*

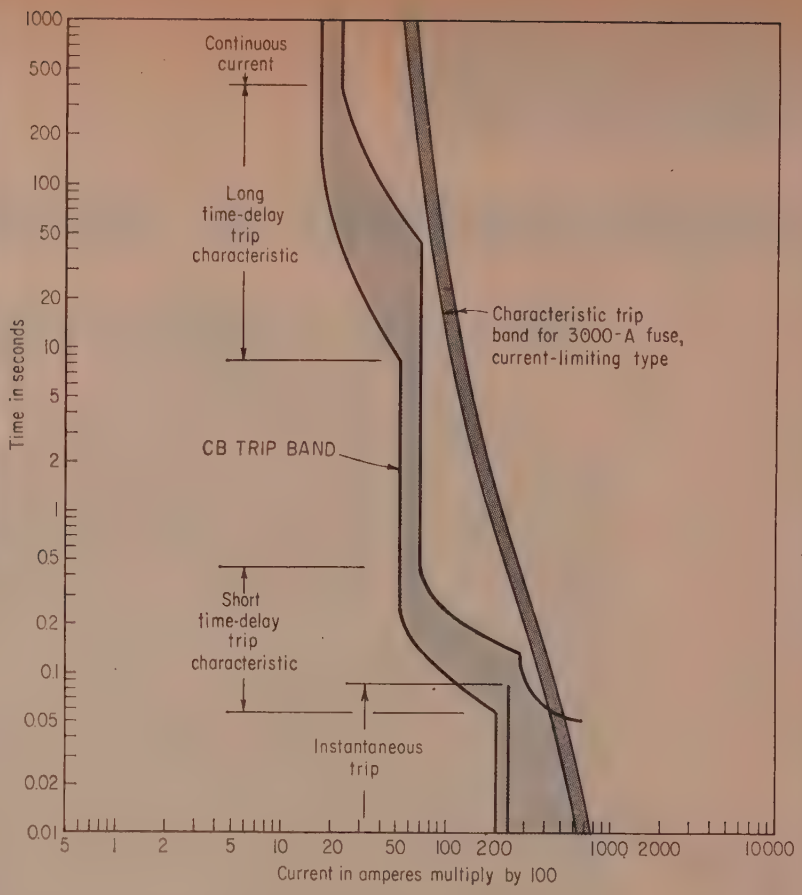
DESIGN of electrical power systems for modern data processing centers is a dynamic thing. Confronted by heavy unit loads with extreme requirements for supply circuit flexibility, the designer must devise methods which provide convenience in electrical use and fully satisfy code and other safety requirements. Because this is a pioneer area in design, the designer must first use his imagination and then spell out his design concept in terms of standard or special equipment properly coordinated and interconnected to fulfill all design objectives. Each and every detail must be carefully executed to assure the overall engineering integrity of radical or novel methods. A typical example of such design is that used in the IBM Data Center, Eastern Region, in New York City's new Time-Life office building.

TYPICAL AREA of computer center has machines arranged for use, with power cables and other interconnecting cables run under the vinyl-covered raised floor. Lighting level of 70 maintained footcandles is provided by continuous row luminaires. Photo shows area during construction.

Electrical design of the IBM computer center was part of our firm's overall engineering service for IBM in their space in the Time-Life building. The computer center occupies 25,000 sq ft of space on the concourse level (first level below ground level). IBM also has office space on the fourth floor of the building. The computer equipment provides businesses with processing on an hourly basis, with some time reserved for IBM and customer education. The center can accommodate 750-kva demand of machine load, making this the largest such facility in the country.

Electrical energy for IBM space in the building is derived from a 4000-amp, low-impedance busway riser in an electrical room on the concourse level. This 480/277-volt, 3-phase, 4-wire feeder bus is part of the building's overall electrical distribution system which was designed by others. Our design began at this busway riser.

Tap from the busway is made through a 3000-amp, 600-volt, electrically-operated power circuit breaker with the trip set at 2000



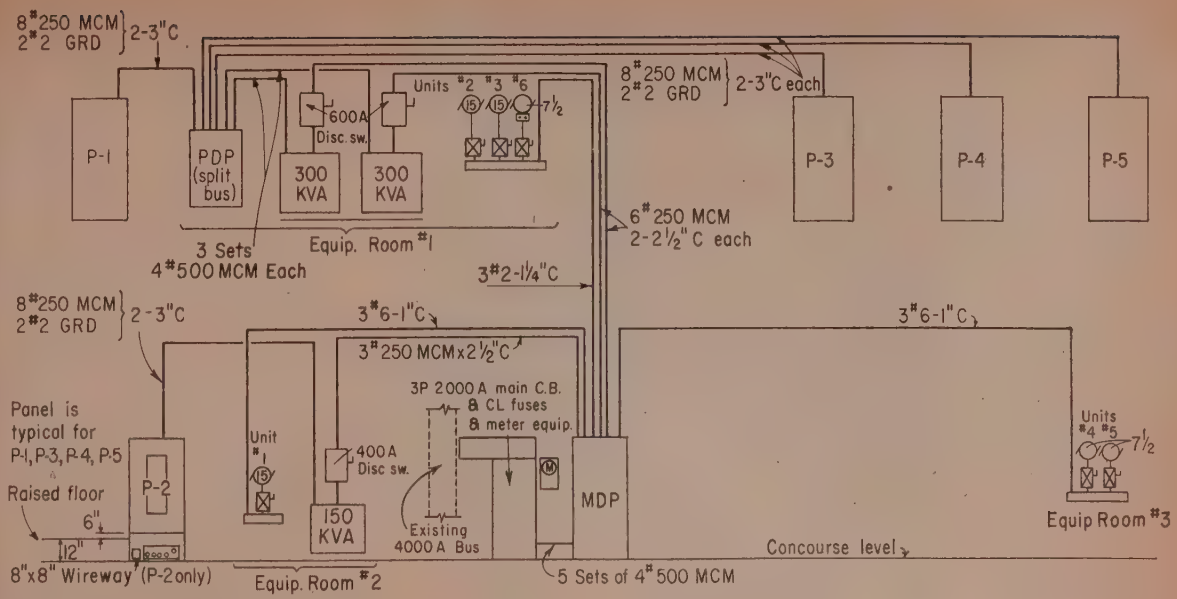
CB AND FUSES of the current-limiting type are combined in this service disconnect cubicle which is suitable for application at points where short circuit duty is as high as 200,000 symmetrical amperes. The 3-pole CB is an electrically-operated low-voltage power circuit breaker with a continuous rating of 3000 amps and an IC of 75,000 asymmetrical amperes at 480 volts. The CB has three magnetic tripping characteristics in a 2000-amp rated trip device. The first, the long time-delay trip, is adjusted to pick up at 2000 amps. The second trip, the short time-delay trip, is adjusted to pick up at 6000 amps. The third trip is the instantaneous trip and is set for 12 times coil rating or 24,000 amps. The tolerance on pickup settings is ±15% for this trip device. The time-delay trips are factory adjusted for minimum delays. The fuses used are rated at 3000-amp continuous carrying capacity with IC of 200,000 amps. The coordination between the fuse operating band and the breaker tolerance band is shown in the graph at right. The combination provides CB operation on faults up to about 60,000 amperes with both devices operating above that value. Tap from 4000-amp busway to the top of this CB is made at left in photo. CT's are shown through open doors at top of cubicle. Main feeder distribution panel is out of sight just to the right in photo and is fed by conductors in gutter at lower right.

amps. This CB has an interrupting capacity of 75,000 asymmetrical amperes at the rated circuit voltage. To provide IC above this value to satisfy duty requirements at the point of application, current-limiting fuses rated at 3000 amps with IC of 200,000 symmetrical amperes are connected on the load side of the CB and coordinated with it in time-current characteristics. The combination provides effective overload and short-circuit protection with preferred operation of the CB up to near its maximum ratings. Only under fault conditions which approach that which the CB cannot clear safely will the fuses operate, thereby minimizing the inconvenience of fuse changing. Any faults above approximately 60,000 amps will be cleared by the current-limiting fuses, although both the fuses and the CB will operate in the region above crossover to the fuses. The above accompanying illustration shows the coordination of the time-current tolerance bands of the CB and fuses.

A main distribution panel is mounted adjacent to the main CB and supplied from it. Five sets of four 500MCM feeder conductors are carried in a gutter from the main CB to the panel. Circuit breakers in this panel feed the following loads: 480/277-volt lighting panels, air conditioning motors, 480-volt dry-type transformers for power to computers, a 45-kva transformer for 120-volt receptacles and the fourth floor office space of IBM.

In the main distribution panel, circuit breakers which feed transformers and air handling units for the computer areas are equipped with shunt-trip coils. These coils are circuited at 277 volts with a fused tap from one main bus to the neutral. The coils are connected in parallel and arranged to be operated simultaneously from any one of a number of momentary-contact pushbuttons strategically located throughout the area. The pushbuttons are wired in parallel so any one can energize all shunt-trip coils. This hookup was required by the client to provide fast disconnect of the power circuits to the computer equipment in case of emergency.

Power supply to the computer machines is made from the main distribution panel through three floor-mounted dry-type transformers installed in equipment rooms. Two 300-kva units are mounted in one such room, and a single 150-kva unit is in a second room. These transformers are for sole use of IBM data processing equipment. Each transformer is primary connected at 480 volts, 3-phase, delta, with a 120/208-volt, 3-phase, 4-wire secondary. The secondary neutral



BASIC POWER LAYOUT of electrical distribution system shows feeders to power loads and to computer area branch circuit panels (P1, P2, P3, P4 and P5). Lighting feeders and panels and the feeder to the fourth floor office space are not shown here.

of each transformer is solidly grounded to the transformer housing by a copper stud and this, in turn, is connected by a No. 4/0 cable to a copper bus bar welded to the building steel.

The secondary of each of the 300-kva transformers supplies two CB's in a distribution panel adjacent to these transformers in the equipment room. From the load side of each of these four CB's a feeder is carried to a branch circuit distribution panel. The secondary of the 150-kva transformer feeds directly to its branch circuit panel. There are five such panels to feed the computer machines, and each panel has a power handling capacity of 150 kva.

Each branch circuit panel is fed by two 3-in. conduits, each containing four 250MCM conductors and one No. 2 equipment ground conductor. In most computer installations, the neutral conductor is not required because power to the machines is generally 208 volts, 3-phase with a fourth wire for equipment ground. In this installation, however, the neutral feeder conductors were brought to each branch circuit distribution panel to assure complete flexibility and adaptability to any future load requirements.

An insulated ground bus is provided in each branch circuit panel for connecting the equipment ground wire from each computer machine. And in each panel, this bus is connected to the No. 2 ground wires run with the feeder conductors from the transformer secondary CB which feeds the panel. Then, at the transformer CB panels, the No. 2 ground wires are connected to another insulated common ground bus. This bus, in turn, is connected by a No. 4/0 cable to the same copper strap which grounds the transformer neutrals to building steel in the equipment rooms.

The power for machines is run from the branch circuit panels, which are wall-mounted at load-center locations in the computer areas. Because exact quantity and types of computer equipment were not known in the design stage of our work, each panel was designed for maximum flexibility. A selection of sizes of molded-case breakers and considerable spare capacity are provided in each panel.

Panel No.	CKT. No.	Circuit breaker				Cable size	Cond. size	Serves
		Frame	Size	Poles	Trip			
MDP	1	KM *	600A	3	500A	6-250 MCM	(2)-2½"C	300 KVA
	2	KM *	600A	3	500A	6-250 MCM	(2)-2½"C	300 KVA
	3	KM	600A	3	400A	4-500 MCM	3½"C	4th Floor
	4	KM *	400A	3	250A	3-250 MCM	2½"C	150 KVA
	5	KM	400A	3	225A	———	———	Spare
277/ 480V	6	K	225A	3	175A	4-2/0	2½"C	LHW-C
	7	K*	225A	3	125A	3-2	1¼"C	Equip. Rm #1
	8	K	225A	3	100A	———	———	Spare
	9	F*	100A	3	70A	3-6	1"C	Equip. Rm #2
	10	F*	100A	3	70A	3-6	1"C	Equip. Rm #3
	11	F	100A	3	90A	3-4	1¼"C	45 KVA
	12	F	100A	3	90A	———	———	Spare
	* Breaker with 277 V shunt trip coil.							

MAIN DISTRIBUTION panel adjacent to the CB-fuse cubicle is made up with molded-case breakers as shown here. The CB's feeding computer transformers and air conditioning fans in the areas are provided with 277-volt shunt-trip coils for remote tripping of the breakers from any of a number of momentary-contact, single-pole pushbuttons mounted 6 ft, 6 in. above the raised floor and located at strategic points throughout the computer areas. Each pushbutton is provided with a protective yoke around the button to prevent accidental operation. Each is provided with an engraved phenolic nameplate, red and white, 5/16-in. letters saying—"EMERGENCY POWER SHUT-OFF FOR ALL MACHINES IN CONCOURSE AREA."

300-KVA TRANSFORMERS mounted in one of the equipment rooms are fed at 480 volts from the main feeder distribution panel. Secondary side of each transformer, rated at 120/208 volts, feeds two CB's in panels at left rear. Each CB protects a feeder to a branch circuit panel in the computer area.

The most interesting and unusual phase of design for a computer center is the layout of circuit wiring for the machines. Extreme flexibility and accessibility are prime requirements of supply circuits to computer machines. Circuiting must readily accommodate movement of machines and frequent change in locations of different power loads over a wide area. This is required by the nature of computer application. Cord connection of the machines is, therefore, an initial conclusion. But the large area of a computer center, the heavy loads and wide variations in circuit capacities quickly precluded the use of a fixed wiring method up to suitable receptacle outlets with cord connection from the outlets. Such an arrangement would seriously lack the required flexibility. Even a plug-in busway system, which would be very expensive under these circumstances, would not provide adequate flexibility and would be unsightly. A suitable method for such computer installations must meet the utilization demands and must also be completely inconspicuous in the area, which is finished as a showroom to customers who buy data processing.

The tried and proven method for wiring computer centers consists of heavy-duty cord circuits run under a raised floor from wall panels. This is the method we used on this job.

The raised floor in this data center consists of 18¼-in. square panels of die cast aluminum, with ⅛-in. thick pure vinyl tile covering the full panel. Adjustable pedestals with locking-type heads support the

RAISED FLOOR, which makes possible the unique method of wiring to the computer machines, is shown here during construction. The pedestals are simply placed in position so that each will support one corner of each of four aluminum floor panels. Each pedestal has two nuts on its threaded end to provide an adjustable stop for vertical positioning of the head piece. This permits leveling of the floor. Floor panels with openings are used where cables come up to machines.

corners of each floor panel, locking in four corners on each pedestal head. The finished panel floor is raised 12 in. above the slab floor and is capable of handling a uniform load of 275 lbs per sq ft and caster load of 1000 lbs. This type of floor is used for the computer areas and for some adjacent office areas. The computer areas can therefore be readily expanded by simple removal of the wall partitions which presently segregate the office areas.

Each computer machine requiring power is fed by a multi-conductor cable with a heavy-duty neoprene jacket. Cables used included: 4C No. 12 for 20-amp circuits, 4C No. 10 for 30-amp circuits, 4C No. 4 for 70-amp circuits and 4C No. 2 for 100-amp circuits. All cables are freely laid under the raised floor. The conductors of each are connected to a CB in the wall-mounted branch panel. Each cable is terminated in a polarized, 4-pole cable receptacle connector of proper size, near the machine it serves. Each IBM machine is equipped with a similar cord and a matching plug which connects to the receptacle under the raised floor.

Cable openings are provided in a floor panel where the cable from each machine is carried through the floor for connection to the power circuit. Cable cutouts are equipped with plastic frames and rubber grommets to assure smooth contact surface for cables. A raised edge on each cutout prevents casters from dropping into the opening when machines are moved about.

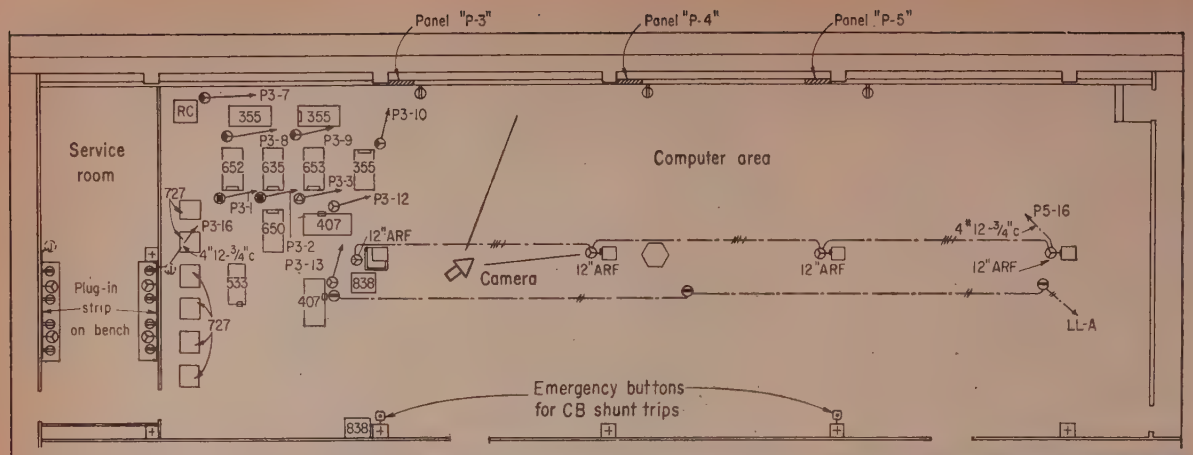
Not all machines in the computer room require a power supply circuit. However, any machine not taking power is connected to a machine which does take power. All such interconnections are made by cables supplied by IBM. Each cable is of predetermined length and size and is equipped with suitable connectors at each end. These cables are also run under the raised floor and brought up through cutouts to the machines they interconnect.

The wiring method used here is not recognized by the National Electrical Code. Special permission is therefore necessary for its application. In New York City, permission to use this method is granted upon request. Other cities, however, require power feeders to be run in an approved raceway. Such application presents many difficulties in running raceways between pedestal supports for the raised floor. Local inspection authorities should always be consulted on such underfloor systems.

Air conditioning throughout the center is powered from 480-volt motors. AC equipment is installed in three equipment rooms, strategically located to supply conditioned air to the plenum under the raised floor. The entire raised floor is used as a pressurized plenum with air entering the computer

Panel No	CKT. No.	Circuit breaker				Cable size	Serves
		Frame	Size	Poles	Trip		
P-1	1	K	225A	3	100A	3-2, 1-8	Machine # 7602
	2	K	225A	3	100A	3-2, 1-8	Machine # 755
	3	F	100A	3	70A	3-4, 1-8	Machine # 7602
	4	F	100A	3	70A	3-4, 1-8	Converter
120/	5	F	100A	3	70A	3-4, 1-8	Machine # 757
208V	6	F	100A	3	70A	3-4, 1-8	Machine # 759
	7	F	100A	3	70A	3-4, 1-8	Machine # 1402
	8	F	100A	3	30A	4-10	Remote compr.
	9	F	100A	3	30A	4-10	Machine # 7300
	10	F	100A	3	30A	4-10	Machine # 7300
	11	F	100A	3	20A	4-12	Machine # 7400
	12	F	100A	3	20A	4-12	Machine # 7500
	13	F	100A	3	20A	4-12	Machine # 7500
	14	F	100A	3	20A	4#12-3/4"C	Receptacles
	15	F	100A	3	30A	———	Spare
	16	F	100A	3	30A	———	Spare

TYPICAL PANEL supplying cord branch circuits to computer machines is flush-mounted in wall of computer area. A hinged wall section provides ready access to panel but completely conceals the panel in the closed position. In this way, the presence of the panel does not intrude upon the clean, modern, brightly decorated computer area. All panels bordering the raised floor are fabricated with a wiring trough, for the full width and depth of the panel, from the bottom of the panel to the existing floor below the raised floor. This trough receives the 4-conductor machine power cables and contains strain relief clamps for securing the cables where they enter the panel. Part of the raised floor is shown removed. A typical schedule for one of the machine branch circuit panels is shown.



LEGEND

- Duplex receptacle, grounding type
- 4W-4P-20A Receptacle, grounding
- Duplex receptacle, grounding, in FS box, surface-mounted on floor slab under raised floor
- 4W-4P-20A
- 4W-4P-30A
- 4W-4P-60A
- 4W-4P-100A

Connectors for machine circuits under raised floor

ARF - Above raised floor

- Pushbutton for emergency operation of CB shunt trips

PARTIAL PLAN of computer center shows one machine area which is only partially occupied by machines and the equipment service room. This layout with its legend shows typical use of receptacles and cord connectors. All of this area utilizes raised floor. Branch circuit distribution panels are recessed in wall as shown. Photo shows part of the area, with the camera angle for the photo as indicated on plan. Numbers in rectangles at left end of plan designate the types of IBM machines.

rooms through baseboard diffusers along the perimeter of walls and columns and leaving through ceiling registers into the hung ceiling which is used as the return plenum. A substantial saving was made in the elimination of supply and return ductwork.

The floor plenum is sub-divided into three areas by metal barriers. This was necessary to facilitate maintaining proper humidity and temperature control, which are so critically important for operation of electronic computers.

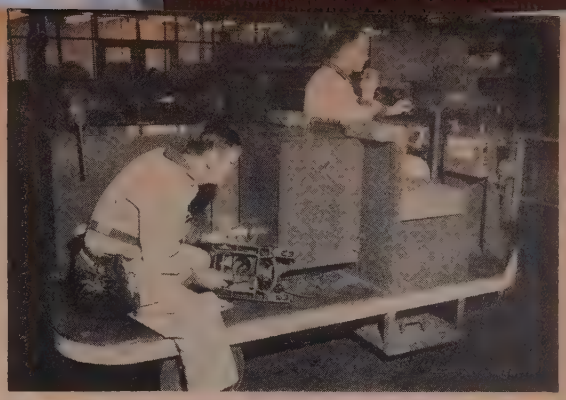
General area lighting throughout the computer center utilizes recessed fluorescent luminaires on 277-volt circuits. Each luminaire contains two 40-watt rapid-start lamps and has a low-brightness lens diffuser. With fixture rows mounted on 6- or 7-ft centers, the installation was designed for 65-70 maintained footcandles. Because the ceiling plenum is used as a return for the air conditioning system, the lighting troffers are provided with a trim gasket to assure an air-tight fit to the acoustic ceiling to prevent air leakage through them.

Incandescent lighting and receptacle circuits are supplied at 120 volts through a separate 45-kva dry-type transformer. This unit is ceiling suspended in an electric closet and feeds three panelboards to cover the area.

MACHINE CONNECTIONS are made by cable from under raised floor, up through plastic cutout frames in panel sections under rear edge of machine. Two solid floor panels are removed here to show the cables and a typical 4-pole power connector. Power cable is run to machine from a wall-mounted branch circuit distribution panel. Other cables interconnect this machine with other machines. When machines are moved within the area, the panels with openings are also moved.

4-WIRE RECEPTACLES are installed in columns in computer areas to supply portable test machines for the computer equipment. Each receptacle is supplied from one of the wall branch circuit panels by four No. 12's in ¾-in. conduit run in the concrete slab under the raised floor. Air registers are shown around base of column. These provide outlet of the conditioned air which is distributed through the raised floor. The same type of register is used along floor perimeters at walls.

NERVE CENTER of the electrical maintenance radio patrol is the dispatcher's station, from which point complete control is maintained over movements of the mobile service trucks to coordinate with the nature and urgency of maintenance.



TYPICAL APPLICATION of this radio-control service setup finds one electrician finishing up the last touches on a job somewhere in the plant while the other crew member contacts the dispatcher for orders on their next service job.

Radio Patrol for

Plant Maintenance

How two-way radio communication provides speed and efficiency in the use of mobile service benches for electrical maintenance throughout a large industrial plant.

IF ELECTRICAL power or any machinery fails at International Harvester's Melrose Park, Ill., plant, aid is only a few minutes away.

Making possible such speed in emergencies are two-way radio-equipped, battery-powered shop trucks. Designed and constructed by the Melrose Park plant, these trucks are actually mobile service benches, containing tool bins, parts, vises, and all other material needed for most jobs. Two experienced electricians ride each truck. The radio equipment was built right into the trucks at the start.

The plant, which manufactures heavy construction machinery, utilizes six radio-equipped vehicles to handle all electrical repair needs. One of these is used for emergencies, such as power failures or conveyor or machine breakdowns. Ordinarily, this vehicle is assigned only jobs that can be delayed if any emergencies occur. Dispatching of all vehicles is handled from one control point. As requests for service come in, the dispatcher radios the order to a vehicle near the request.

The use of these shop vehicles has proved beneficial to the Harvester plant in two ways:

1) It has enabled the plant to eliminate the stationary service benches; and 2) it has put a foreman on every repair job for consultation.

The radio-equipped trucks were put into operation in September of 1959. Before then, four stationary service benches were situated throughout the plant. Since the trucks came into use, the stationary benches have been eliminated, gaining valuable space for production and freeing electricians for construction work. The mobile benches not only reduce the number of men needed, but give better service because they can be moved to the scene of a repair assignment.

Radio in the shop vehicles makes possible three specific advantages:

1. It gives the plant speed in getting to jobs.
2. It reduces mileage.
3. It provides greater control of the electrical servicing department.

Getting to particular repair jobs in a hurry is imperative. Breakdowns of conveyor belts or machines slow production and put large numbers of people out of work temporarily. The battery-powered vehicles can be dispatched to a job in a matter of seconds. When the electricians get there, they have all the material needed for making a fast repair.

The second benefit—a reduction of mileage—occurs through proper dispatching of vehicles. One vehicle can handle two or three requests for service in the same general area. The dispatcher radios the electrician each order as it is received. Without the radio system, the vehicles would be returned to the pool after each request is filled.

Greater control of the service department is achieved through the radio system because the dispatcher knows the whereabouts of all his electricians at all times. The locations of all crews are kept on a large map at the shop. Magnets represent each crew.

Motorola Industrial "Dispatcher" radio units are utilized by the Harvester plant. These 8-watt compact units blend well in this application because they can be easily mounted on the dash of the trucks and require only a minimum of space. Transistorized as well, these units are ruggedly built to take any jarring that results in the normal operation of the shop trucks.

The radio system includes a 25-watt utility base station and antenna, which is mounted on the roof of the plant approximately 45 ft in the air. The system operates on the 153.35 mc band.

All maintenance of the radio system is performed by an authorized service station, Industrial Electronics, Chicago.

A Camera Visit to

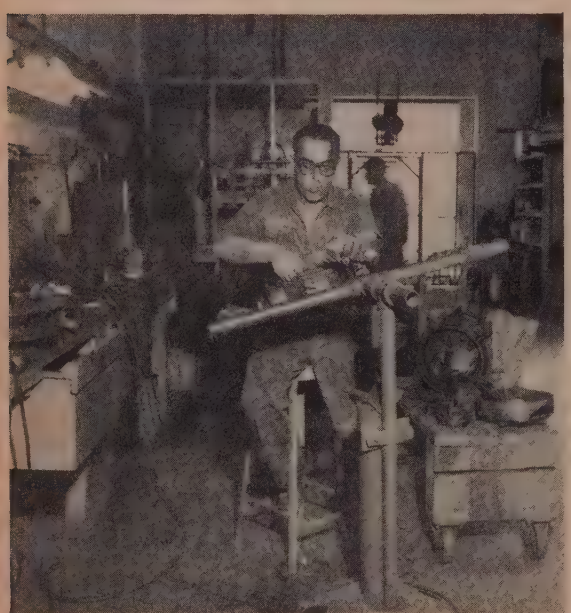
Motor Shops In Miami

Here are some of the service shops, including typical equipment, and methods of operation and servicing electrical apparatus, located in the Miami area where the National Industrial Service Association will hold its 1960 Annual Convention early next month.

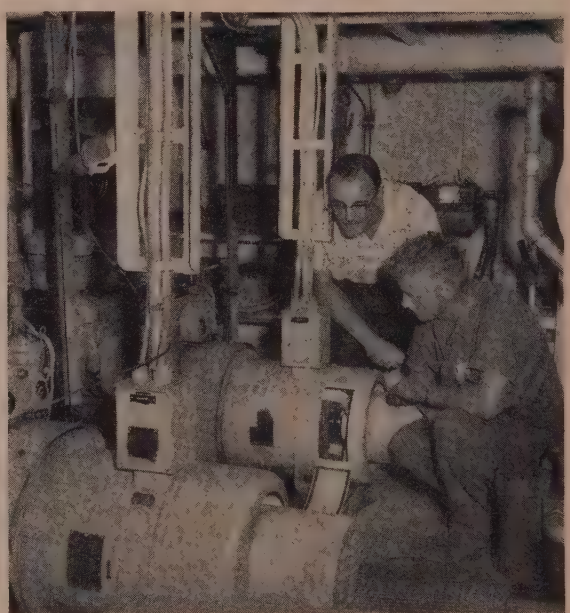
THE 1960 annual convention of the National Industrial Service Association will be held May 8-11 at the Fontainebleau Hotel, Miami Beach, Fla. Under the general chairmanship of Michael Assalone, of Florida Electric Motor Co., Miami, a well rounded four-day program of business sessions, social activities, and tour of local shops has been planned.

On the program for the business sessions are talks on a wide range of subjects, to be presented by authorities, both NISA and non-NISA members. These include, for example: "Know Your Assets," by Norman D. Johnson, Allis-Chalmers Mfg. Co., Milwaukee; "Distributor Sales," by A. C. Allen, Wagner Electric Corp., St. Louis; "Credit, and How It Affects Customer Relations," by Roy Bliss, Dow Corning Corp., Midland, Mich.; "Customer Relations," by Col. M. M. Frost, Eastern Air Lines; "Expense Accounts, Tax Laws, and Depreciation," by William B. Mills, St. Joe Paper Co., Jacksonville, Fla.; "The New Look of Employee Benefits," by Paul L. Miller, Miller & Horovita Associates, Jacksonville, Fla.; "Personal Health," by Dr. Edward R. Annis, Miami, Fla; "How Can Management Be Kept Informed Concerning New Developments In Electrical Insulation Systems," by Dr. Jack Turner Wilson, Louis Allis Co., Milwaukee, Wis.; "Sizing Up People," by Byron B. Harless, Byron Harless & Associates, Tampa, Fla.; and others. Keynote speaker will be E. E. Helm, president, Reliance Electric Engineering Co., Cleveland.

Condo Electric Service, Miami, Fla.



DEVICE for holding an armature, which locks into place easily, is used at Condo Electric Service. Built by shop personnel, this device can be turned easily to get armature in the exact position desired by the workman.

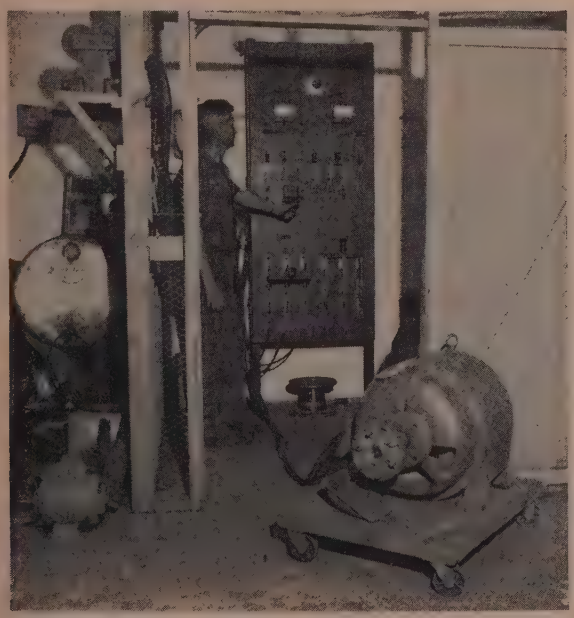


25-KW GENERATORS in the hold of the "Virginia B," Belcher Towing Co. tug which the shop is checking over for service, are inspected by Harry E. Condo, manager (left), and Les Sauer, specialist in marine equipment repairs and service.

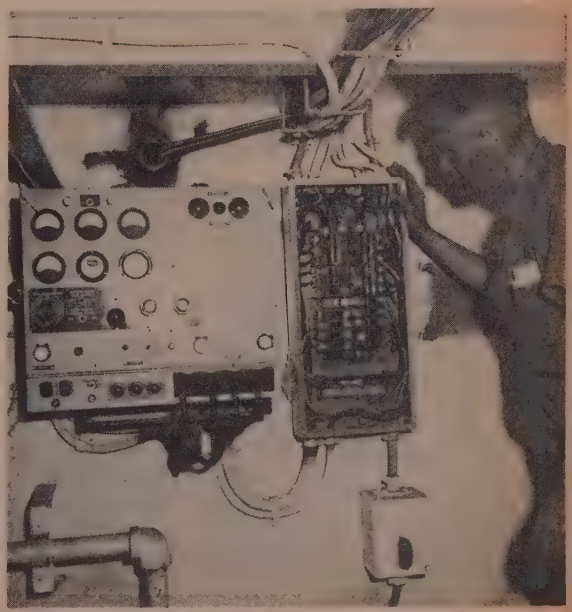
All Phase Sales & Service, Miami, Fla.

METAL SHELVING was used to get maximum storage space in a relatively small area, when Wesley L. Bowerman, owner, recently rearranged his parts bins. The well-marked boxes save employees much time in locating needed parts, and make for a more efficient operation, according to Mr. Bowerman.

IMPACT WRENCH is used on a 3-hp motor by John Schnupp, as he performs a typical operation in this Miami shop.



TESTING unit in shop is demonstrated by Les Sauer. Separate enclosure guards shop personnel from accidents when unit is not in use.



CONTROL PANEL in engine room of "Virginia B," New Orleans-built ship towed to Miami for complete electrical checkup by Condo Electric Service, is examined by Les Sauer as he gets this new tug ready for sea. Condo specializes in this type of work.

King Electric Motor Service, Miami, Fla.

NEW FRONT was added to King Electric Motor Service last year. Shop entrance at left has room for two trucks to load or unload. Salesroom at right leads to offices in center of building which includes a separate coil winding department as well as burn-out and baking facilities.

TWO EMPLOYEES in the King shop in Miami, here shown at work bench, are utilizing nature's air conditioning through the open doors in the background, which is a daily occurrence in Florida's sunny climate. This shop also specializes in small motor repairs.

Jack's Electric Motor Repair, Inc., Fort Lauderdale, Fla.

TWO BUILDINGS are used by Jack's Electric Motor Repair, Inc., Fort Lauderdale, with both buildings located within the same city block but each on different street. The main building is shown on left, and the supply store, with owner Lewis S. Bain shown in front, is shown on right, above.

PORTABLE electric tool department is the site of warranty work for many major lines of electrical tools in Southern Florida.

Peninsular Armature Works, Miami, Fla.

ONE OF Florida's largest shops is Peninsular Armature Works, in Miami, which maintains what is believed to be the only independent shop for the repair and rewinding of aircraft electrical components, a "shop within a shop" which numbers among its customers many major airlines. Here, superintendent N. A. Richardson displays a few of the parts which are assembled in his department.

VIEW of main winding bench area of the Aircraft Department shows how each bench is a self-contained unit. The shop must meet rigid government inspection regularly, including periodic checking of its instruments every three months. The floor plan is registered with the Civil Aeronautics Authority, which must be notified whenever a piece of equipment is moved.

REAMING end bells is done at this bench, one of three benches which comprise the major working area of this shop. Note the open door in background.

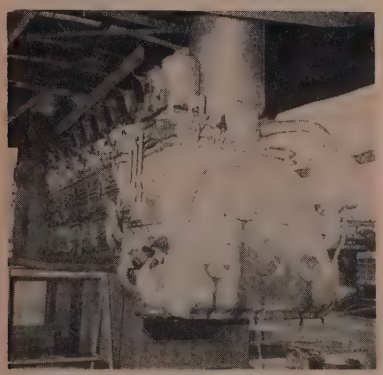
USED MOTOR stock enables shop to help its customers out by loaning a unit while defective motor is being repaired. Well-arranged stock is stored on shelves which extend to ceiling on both sides of room.

COIL WINDING is done in separate department at King shop, and includes the winding machine shown, an adequate supply of winding heads, and a large inventory of wire, tape, etc.

SERVICE COUNTER at supply store is adjacent to tool repair department. This building is for merchandise and tool service, and the other building is for regular motor repair work.

HOIST arrangement at door of motor repair shop enables workmen to handle heavy equipment which they load onto or unload from the trucks or, as in this case, to an outside paint spray booth.

SOLUTION of epoxy compound is being measured out by an employee, demonstrating that the use of new materials is becoming more typical all the time in modern electrical apparatus service shops.



DIESEL generating plant shown here is one of two 750-kw, 600 rpm units rebuilt by Peninsular Armature Works for a power plant in Freeport, Grand Bahama Island. About two months were required to assemble these units, including the fabrication of the bases.

COUNTER at Peninsular is attractive, does a big business in parts and motors. Main shop area begins at far left, extends behind parts department. Offices are at right, and the aircraft shop occupies the second floor.

SMALLEST of three sizes of dynamic balancing machines made and sold by Peninsular is here exhibited by Sales Manager Ralph Swat. The firm has long been known throughout the electrical apparatus service industry for these machines, and Mr. Swat estimates that more than 1,000 of these "plane-lock" machines have been sold to motor shops throughout North America.

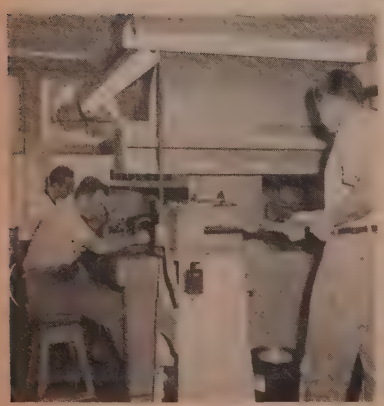
C & H Electric Company
Miami, Fla.

HOIST at rear door entrance to shop proves handy, helps owner Jimmy Roper load and unload motors and heavy equipment from pickup trucks.

Florida Electric Motor Company, Miami, Fla.

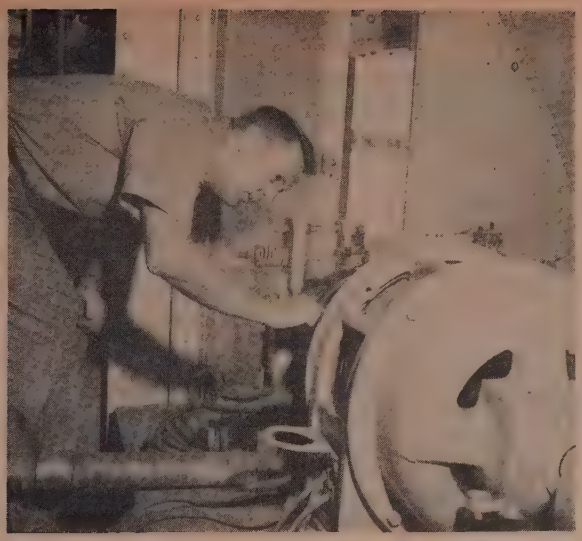
FRONT area of shop of Florida Electric Motor Co., located only a few blocks from downtown Miami business district and of typical Florida architectural design, features parking spaces for customers and the shop's delivery trucks.

ASSEMBLY department features well-lighted work benches, space for several employees, a compact arrangement which makes it possible to turn out a large volume of work in a relatively small area.

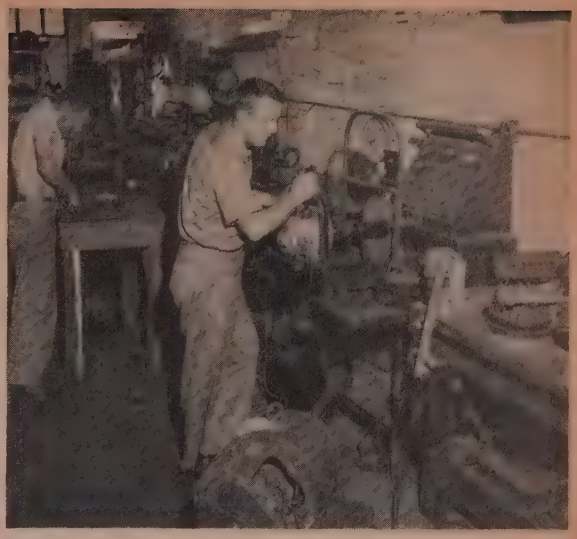


THREE MEN are able to work comfortably and efficiently in the relatively small area of the single phase winding room quarters because of the good layout of the equipment and space (left).

PORTABLE electric tools are repaired in this special department designed for that purpose in this shop, one of Miami's largest, which specializes in small motors. The shop's manager is Mike Assalone, who is also the general chairman for the NISA convention (right).



REPAIRING drawbridge slipring motors is a typical job for Jimmy Roper. The difficulty of removing the motors from the crowded quarters under the bridges, which span several rivers in the Miami area, makes on-the job service desirable. When a breakdown occurs at rush hour, it calls for fast action on the part of servicemen, who are on call 24 hours daily.



DYNAMOMETER inside the shop helps Jimmy Roper to test the motors which he repairs for Miami commercial establishments. Absence of large industrial plants in the city means that service shops concentrate, for the most part, on motors and electrical apparatus for refrigerators, air conditioning, marine, and light industry.

MOTORS which are received at the shop's receiving counter move down a roller conveyor to the disassembling department, shown in back of employee who is removing a motor.

ALL MOTORS, except the very large ones, begin their journey through the shop's assembly line with their first stop in the disassembly department.

TEST BOARD is being demonstrated by H. Ed Grant, owner, who also owns the Tennessee Electric Motor Service in Nashville. Test board was designed and built by Mr. Grant.

REVOLVING arrangement in the paint spray booth permits employee to paint a motor without handling it, once it has been placed on the revolving stand (left).

LARGE EQUIPMENT, such as this motor, is handled separately at this shop. The efficient assembly line set-up has been designed for repairing small motors only, which make up the larger part of the shop's volume, and large units can be handled more efficiently on a special basis (right).

A Study of Estimating

By Ray Ashley, *Research and Consulting Engineer, Oak Park, Ill.*

TABLE I
COST OF ESTIMATING ELECTRICAL WORK*

TYPE OF INSTALLATION	SIZE OF PROJECT (Estimated Base Cost)			PERCENTAGE OF BASE COST FOR ESTIMATING**		
	Max.	Min.	Av.	Max.	Min.	Wtd. Av.
Alterations (Small)	$745.	$98.	$384.	8.20	0.78	3.05
Alterations (Large)	36,637.	876.	5,687.	2.20	0.78	0.84
Apt. Bldgs. (Over 6 Apt.)	23,136.	657.	3,434.	2.70	0.30	0.73
Churches	4,586.	284.	2,060.	1.97	0.81	1.33
Factories	25,734.	243.	5,254.	6.10	0.33	0.80
Gas & Serv. Stations	3,292.	94.	808.	2.60	1.17	1.55
Hospitals	28,800.	2,352.	14,501.	2.30	0.24	0.48
Hotels	105,659.	3,822.	31,008.	1.22	0.12	0.27
Office Buildings	714,744.	657.	94,895.	1.56	0.12	0.16
Residences & Small Apts.	1,770.	93.	474.	2.80	0.52	1.55
Schools and Libraries	26,364.	342.	5,182.	2.28	0.31	0.83
Stores	17,043.	114.	1,462.	3.90	0.72	1.23
Theaters	37,686.	1,100.	10,100.	1.76	0.16	0.46
Miscellaneous	438,735.	116.	14,645.	4.45	0.09	0.33
All Types of El. Const.	.....	.....	.....	....	....	1.04

* Values from a pre-war survey of 1000 selected projects
** The percentages include an allowance for incidental time and office expense.

TABLE I—Cost of estimating individual jobs varies with type and volume of work and project category. Note range of cost percentages over span of listed classifications.

TABLE II
AVERAGE NUMBER OF BIDDERS

Alterations (Small)	2.2
Alterations (Large)	4.4
Apartment Buildings (Over 6 Apts.)	2.4
Churches	6.0
Factories	3.2
Gas and Service Stations	2.2
Hospitals	5.0
Hotels	7.3
Office Buildings	7.0
Residences and Small Apts.	1.6
Schools and Libraries	5.4
Stores	2.6
Theatres	4.0

TABLE II—Number of bidders per project varies with type of job figured in competitive bidding scramble. Generally accepted average is five.

THE numerous factors influencing estimating expenses and the seemingly limited application of any figures established for same, tend to discourage extensive studies. However, estimating is a basic function of electrical contracting and any studies made are of value.

The most valuable gain from such studies is the development of a faculty for utilizing the estimator's time to the best advantage. Along with this goes a diminished gamble of estimating expense.

Later, use of the estimator's time will be investigated more carefully. First, we must learn something about costs. The following factors must be considered:

1. Variation in a given class of work.
2. Effect of work postponed.
3. Cost of refiguring work.
4. Number of bids taken.

Too often only "start to stop" time is figured for the individual project. Without allowances for the effect of the above items, the results are misleading.

Variations In Work Class

We must not only study the cost of estimating various types of construction, but also learn of the variations that occur in each type.

Table I list a variety of installation types with minimum and maximum costs for estimating. Immediately we see there can be a wide variation for work in a given class. Reasons for this are:

1. Size of project.
2. Nature of plans and specifications supplied.
3. Characteristics of the individual project.

To appraise the cost of estimating an individual project, one must have experience enough to appreciate the effect of these three factors.

Postponed Projects

When deciding to estimate a project, one must consider the possibility that it may be postponed. In boom times, this is not serious

Costs

An analysis of factors influencing estimating costs plus a suggested method of determining your own cost percentage.

because only a small percentage of jobs that reach the estimating stage do not go ahead. In dull times, many projects are shelved when the owner learns the estimated cost. For example: During a depression period 38.1% of 1,000 jobs of all classifications that were checked never were started. When jobs are shelved, they either never go ahead or must be entirely refigured when revived.

Refiguring Work

In most cases, it is hard to foresee whether or not a project may have to be refigured. High-class residences, churches, schools and other community projects usually are among the general group calling for revised bids.

Revised plans usually are the result of over-ambitious layouts or too much optimism regarding the amount of money that will be available. At times, contractors are obliged to spend a great deal of money refiguring plans. Had they suspected this ahead of time, they would not have figured the original job.

Number of Bids

The number of bids taken on a single project often runs very high. Contractors generally think of competitive work as having an average of approximately five bids per project. Table II indicates that, for all practical purposes, five is not a bad figure to use.

Some projects only have two or three bidders. So, if the average is five, there will be cases where the number will be seven, eight or more.

Assume that we have six general contractors taking bids and the average number of bids taken per contractor is five. This means a total of 30 electrical bids for one project. Out of the 30, some will be duplicates. However, chances are very good that 10 or 15 different electrical contractors will be represented in that number of bids.

There is a case on record where 34 electrical contractors were bidding on the same industrial building. Such extreme cases must be omitted from surveys and studies if representative results are to be obtained.

Actual Cost of Estimating

To study the effect of the foregoing factors, we can assume the following and work out an example:

Specifics

Type of project.....Hospital
Base Cost of Estimating (Original estimated Cost of Job). 0.48%
Increase in cost for refiguring 1.0%
Ratio of jobs completed to jobs figured ..... 10 to 11
Number of jobs estimated per contract received 5

Estimated Cost per Contract Received: (Percentage base job cost)

Base Cost of Estimate (Percent of Estimated Cost of Job)	0.4800%
Increase in cost for refiguring ....1%....	0.0048%
	0.4848%
Add 10% for projects that never go ahead	0.0485%
Total Cost of Estimating a Single Project	0.5333%

Cost per Contract Received (5×0.533) = 2.6665 *Use* 2.67

This figure does not match the 2.4 figure in Table III because it is increased by including cost of refiguring and loss due to projects not going ahead.

The difference between the 0.48% (the cost of figuring the individual project) and the 2.67%

(*Continued on page* 299)

TABLE III
APPROX. ESTIMATING COST PER CONTRACT*

TYPE OF WORK	Av. No. of Bidders	PERCENT OF BASE COST	
		The Job	Per Contract
Alterations (Small)	2.2	3.	6.60
Alterations (Large)	4.4	0.84	3.67
Apartment Bldgs. (Over 6 Apts.)	2.4	0.73	1.75
Churches	6.	1.33	7.98
Factories	3.2	0.80	2.56
Gas and Service Stations	2.2	1.55	3.41
Hospitals	5.	0.48	2.40
Hotels	7.3	0.27	1.97
Office Buildings	7.	0.16	1.12
Residences and Small Apts.	1.6	1.55	2.48
Schools and Libraries	5.4	0.83	4.48
Stores	2.6	1.23	3.20
Theatres	4.	0.46	1 84

* Values are based on bids taken. Costs are increased by having to refigure work and jobs that do not go ahead.

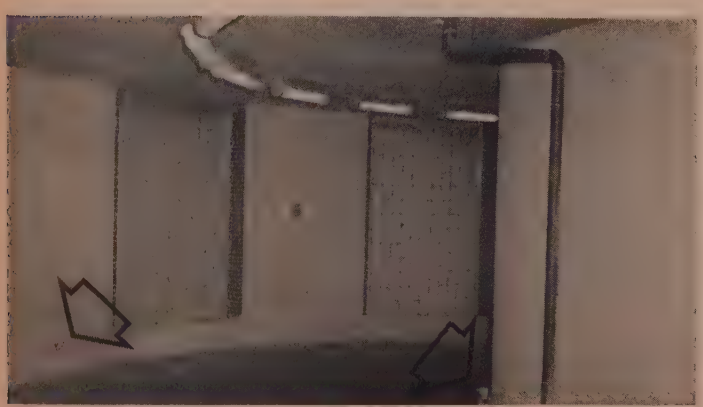
TABLE III—Industry cost per contract for estimating electrical work is proportional to the number of bids received. An office building with seven bidders takes 1.12% of the base cost of bid (seven times the 0.16% for each estimate).

NIGHT VIEW shows the effective lighting system in Rochester's latest public parking ramp. Fixtures mounted on the outside of the third level illuminate sidewalk areas below. Floor-to-floor entrance and exit ramps are located at each end of the building. Exit ramp is in the foreground. The eight-level structure has 551 metered parking stalls.

Public Parking Ramps Go All-Electric

Elaborate electrical systems protect patrons, speed up traffic flow and cut operating costs in Rochester, N. Y., public parking ramps.

By J. H. Watt

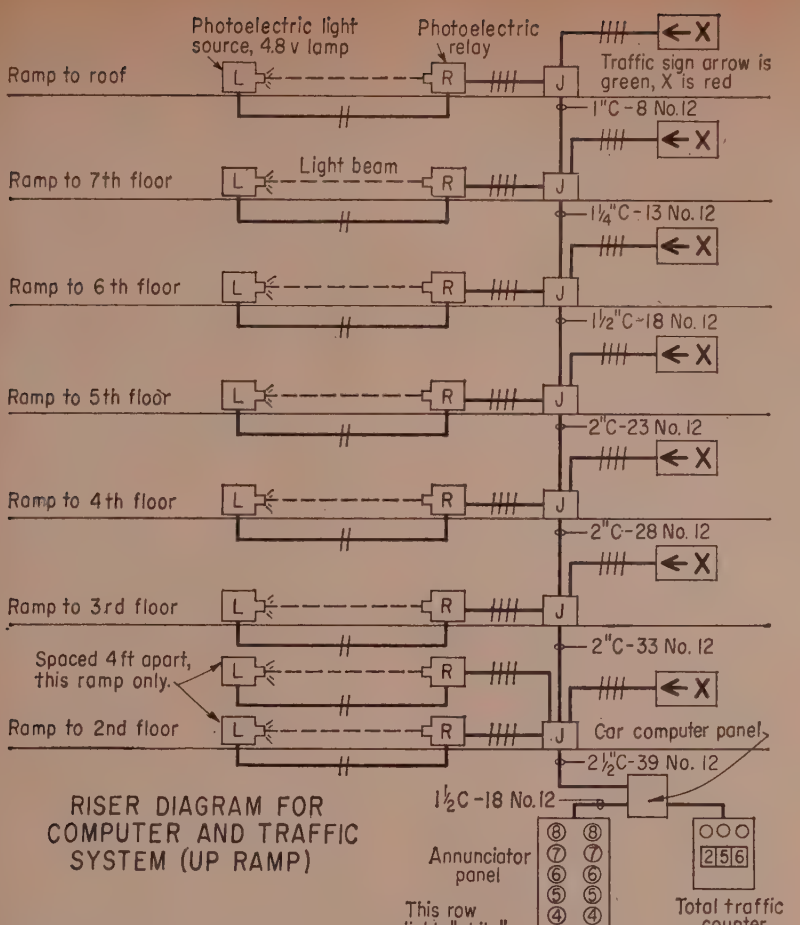


FLOOR-TO-FLOOR CAR RAMPS are well lighted with surface-mounted fluorescent luminaires. Photoelectric relay unit, shown near the floor, transmits an impulse to a computer panel as each car passes through a light beam. Computer records the number of cars entering and leaving the garage or each floor level through photoelectric relays (arrows) in each ramp.

THE third of Rochester's municipal parking ramps is an eight-level structure with 551 metered parking stalls. Experience gained from two previous parking ramps, plus the determination of city officials and the architect to improve the efficiency of operation, have made the new Clinton-Franklin parking ramp into a truly all-electric show place.

With a service capacity of 1200 amps at 120/208 volts, electrical systems and equipment offer a major contribution to this successful and practically automatic enterprise.

Interior and exterior areas are well lighted. Electric computer systems maintain an accurate count of cars and automatically operate traffic lights at each level. Three high-speed, self-operated elevators provide rapid service for patrons after they have parked their cars. Waiting room, rest rooms and the elevator penthouse are electrically



RISER DIAGRAM for the computer and traffic system shows the conduit and circuit arrangements to all floors. As cars break the photoelectric beams in each ramp level, impulses are relayed to a computer panel. There the computer maintains an accurate car count on each floor, and relays the total number of cars to a total traffic counter panel. When each level becomes full, traffic lights operate automatically in the up ramps.

heated with unit heaters. An electric water heater supplies the hot water in the rest rooms. For the protection of patrons, an elaborate two-way loud speaker system covers all areas of the structure. And telephones are centrally located on each floor for contact with the attendant's office.

Lighting

Adequate lighting throughout the structure provides clear vision for parking patrons and discourages criminal activity. Because of the latter, all exterior sidewalks and approaches around the building are lighted in the evening hours.

About 1100 fluorescent luminaires light the parking areas and the floor-to-floor car ramps. Most of the units are single-tube, 4- and 6-ft, with two-lamp units located near stairways and elevator landings. All fluorescent lamps are cool-white, T-12, and have 1000-ma ratings. Lamp enclosures are clear Plexiglas.

Due to thin slab construction, all fixtures and EMT in the parking and car ramp areas are surface-mounted. Each fixture is secured to two preset inserts with ⅜-in. bolts. Accompanying photos show typical lighting arrangements in these areas.

Remote control of general lighting is extremely unique. A master remote-control switch is in a locked enclosure at the elevator landing on each floor. At any of these points an attendant can turn all general lighting on or off. When a floor closes, should someone shut off the lighting while an attendant is on one of the upper levels, the latter can turn the lights on again until he reaches the main floor.

In the main floor office a master control panel is arranged so that any one of five groups of lights on each floor can be controlled individually. Individual group control is provided because two sides of the garage are open, and certain areas do not require lighting during daylight hours. A master switch on the control panel can turn all ramp lighting on or off.

Four aluminum pole standards, each with two 400-watt mercury vapor lamps, and two 400-watt mercury vapor lamps attached to the penthouse, provide the lighting for the roof parking area. They operate during the evening hours only.

Lighting panels are located on each floor outside the elevator shaft. Generally, each panel has five split buses, which are controlled by relays through the remote control switches previously described.

Minimum conductor sizes for lighting branch circuits are No. 12, with longer home runs proportionally increased to No. 6 to minimize voltage drop.

Two-lamp ballasts were placed in every other single fluorescent fixture in the general parking areas.

Car Computer and Traffic System

A specially designed computer system adds and subtracts the number of cars that enter and leave the parking ramp. And it provides the attendant with an accurate total count of cars in the building at all times. Besides this, it operates ceiling traffic lights outside each up ramp level.

Because the attendant's office is on the main floor, cars are counted manually on that level. For the upper levels the computer system takes over. When the first floor parking spaces are full, the attendant posts a "FULL" sign, which directs traffic to upper level ramps. As a car passes through the up ramp to the second level, it operates two photoelectric relays (spaced 4 ft apart), which in turn send an impulse to the computer center, and the car registers on the total count indicator.

Two photoelectric relays were used in the first floor up ramp because of the possibility that drivers, who park on the second floor, may walk down the ramp to the street level. With the relays spaced 4 ft apart, a pedestrian cannot interrupt both photoelectric beams at the same time. Therefore, the computer will not register a count. Above the second floor level, all ramps contain single photoelectric relays. It was felt that pedestrians would hesitate to walk down these upper ramps, and that they would use the elevator or stairway.

When a car parks on the second floor, it tabulates on the total count above the main floor. If the car continues to the third floor, it registers on the total count above the second floor. This sequence follows similarly to the roof level.

As each level reaches five or less vacant parking stalls, a white light flashes on the left side of an annunciator panel in the attendant's office. This warns the attendant that this particular level is near capacity. And when the count reaches full capacity on any given floor, a red light with the corresponding floor number lights up on the right side of the annunciator.

At the same time the red light appears on the annunciator panel, the ceiling traffic light on the respective floor flashes a red "X" signal on the right side of the indicator. A green arrow on the left side of the traffic indicator directs approaching cars to upper levels that have vacant parking stalls.

Because this computer and traffic signal system has operated so successfully, the number of attendants required was reduced. And cars can leave the parking ramp at the rate of ten cars per minute during peak hours.

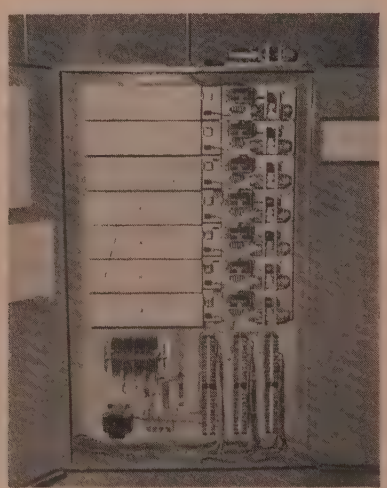
Over 100 two-way loud speakers are strategically located throughout the structure, including speakers in each elevator and rest room. An attendant, on duty in the main floor office, can pick up a conversation anywhere in the building. If a conversation indicates that someone is in trouble, the attendant can immediately determine the floor level on which the trouble has occurred through selector switches on the speaker control panel. Calls can then be made to attendants in any part of the building, and they can lend assistance to the party in distress. During the day music recordings are sent through parts of the speaker system.

Other functions of the speaker system include: 1) transmitting announcements from the central office to all floors, simultaneously; and 2) originating and carrying on two-way conversations between the central office and any selected floor.

If a motorist cannot start his car or has some other difficulty, he can make a call to an attendant at public phone stations provided at the elevator landings on each floor. Should an attendant be required to leave the main office unattended, he can operate a transfer switch at the phone desk before leaving. Then as incoming calls are made, loud alarm bells ring on each floor. And

FOUR ALUMINUM LIGHTING STANDARDS each contain two 400-watt mercury vapor luminaires, and with two additional mercury vapor fixtures which are mounted to the elevator penthouse, provide the lighting for the roof parking area during evening hours. Up ramp entrance to the roof from lower levels is shown in the background.

JOSEPH GAITER, Supervisor of Parking Ramps for the city of Rochester, points to the remote control switching panel in the main floor office. Remote control switches are laid out to conform to the respective groups of lighting on each floor level. The first and last switches each control two outside rows on each floor. A master switch can control all lighting.



AUTOMATIC COMPUTER panel consists of seven draw-out computer units for easy replacement. Attendant can determine the number of parking spaces available on each floor by reading the meter on each unit. Total car counts are recorded in a master traffic counter which is fed from this panel. Computer registers an accurate traffic count at all times.

an attendant can answer the call at any of the phone stations in the building.

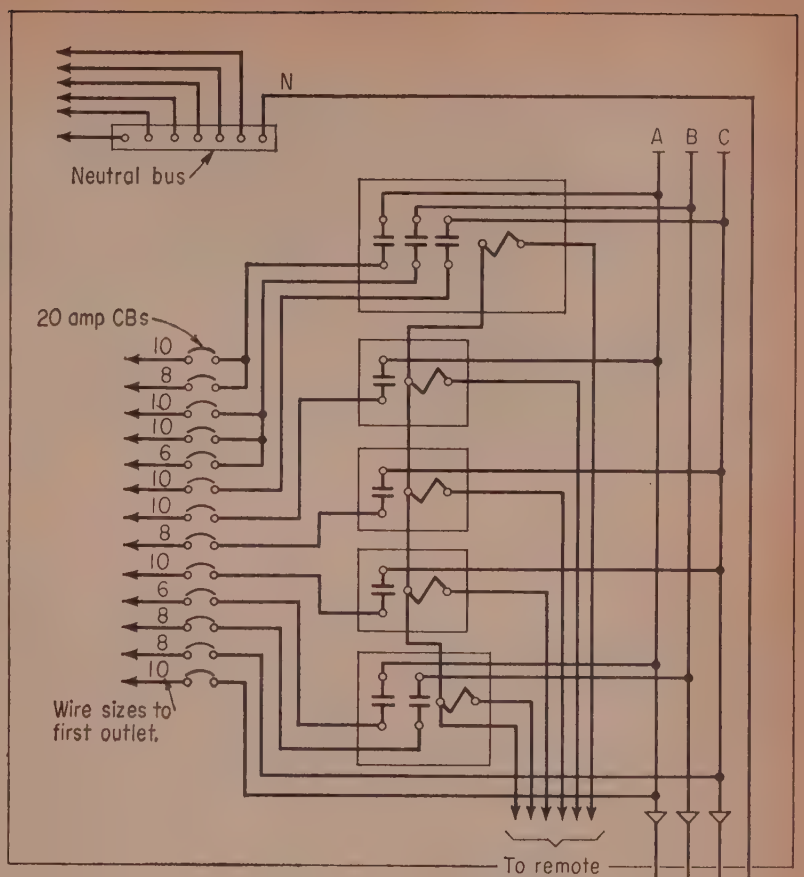
Sound system supply comes from a 50-watt amplifier unit, which is located on the main floor near the sound control panel. Adjacent to the amplifier unit is the automatic record player, which feeds into the amplifier unit whenever music recordings are played. Music recordings were first used on a temporary basis. It ended up becoming a permanent installation.

Electric Heating

Forced-air, electric unit heaters, suspended from the ceiling, provide the heating in the main floor waiting room and rest rooms, and in the elevator penthouse. Separate thermostats regulate the heat in each room. The total connected heat load is 73 kw for 7-10 kw and 2-1.5 kw units.

Electrical contractor for the Clinton-Franklin Ramp was the Vanderlinde Electric Corporation of Rochester, N. Y. The firm of Bohacket and Flynn was the architect, and they designed the electrical system.

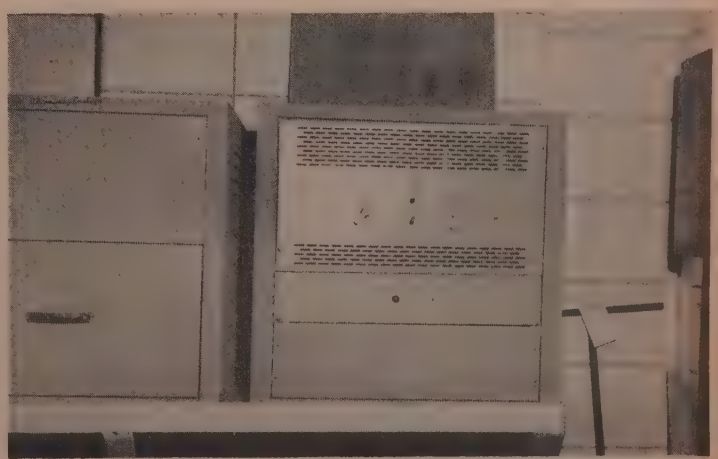
Public acceptance of the parking ramp program has been so overwhelming that construction will start this spring on a 2000-car ramp garage.



TYPICAL
5-SECTION LIGHTING PANEL
WIRING DIAGRAM

WIRING DIAGRAM shows a typical arrangement of lighting panelboards with contactors and branch circuit breakers. Seven of these panelboards are split into five sections, and remote control switches operate each section. Typical panels are located on each floor, and seven rows of lighting can be group controlled. Master switches are located on each floor which can operate all building lights simultaneously.

EACH FLOOR LEVEL has a telephone to the left of the passenger elevator landing. Patrons in need of assistance can contact an attendant through these phones. To the left of the telephone a remote control switch is contained in a locked enclosure. Attendants can turn all general lighting on or off at this point on each floor.



SOUND EQUIPMENT is mounted on a specially-constructed rack near the sound control panel on the main floor. Unit on the right is a 50-watt amplifier. On the left is an automatic record player, which can be fed into the amplifier to play music recordings in parts of the building. Over 100 two-way loud speakers are connected to the sound system.

Electric Heating For Our Church

Factors influencing the New Brunswick Church of Christ to go all-electric in its new sanctuary.

By Rev. Dean Burton,

New Brunswick Church of Christ
*Lebanon, Ind.**

ELECTRIC heat was chosen for our New Brunswick Church of Christ, Lebanon, Ind., by a group of men consisting of 14 farmers, 3 factory workers, 1 carpenter, 1 school teacher, 1 trucker, and 1 preacher. Not one of these heats his home electrically. It was quite a venture of faith and required a great deal of study before the final choice was made. The decision was not made hastily or without serious consideration of the possibilities and problems. An unwise choice could be the ruination of a building program, and of a local congregation.

Reasons influencing the decision go back to the planning stage. The purpose of the new sanctuary had to be thought through carefully. We wanted a room which provided a worshipful setting. The congregation coming here must be aided in worship and not hindered. Our people are not wealthy, so an elaborate or pretentious building would be out of place in our town with 35 population (9 homes). The space to be heated amounted to 3720 sq ft (44,260 cu ft), including a sanctuary and overflow seating 400, three vestibules, a baby cry-room, and an office. The method of heating would bear greatly on achieving or defeating our purpose.

Here, then, are the things we expected from electric heat, with our observations after living with it for a year:

(1) *Elimination of a furnace room and flue* would solve a real space problem. All electric heating control equipment could be contained right in the sanctuary proper or in the rooms being heated, without detracting from the building and without using valuable space needed for other purposes. This was important to us.

(2) *Economy* seems to be an ever-present factor with which to reckon in churches. When we first began to talk electric heat, we heard the cry, "It will cost too much to operate." One heating engineer told us, "Don't use electric heat unless you have some millionaires in the congregation." Frankly, these warnings had us worried. But we heard many estimates, read numerous figures of other heating situations, and finally decided it was a good risk. We could have installed other type heating at less initial cost, and we could have spent less by using just baseboard-type heating units. But with all our needs considered, we chose to install two 14-kw school-room unit ventilators and eight baseboard heaters totalling 10 kw in the sanctuary, a 3-kw convector-type heater in each of the three vestibules, a 1250-watt baseboard heater in the baby cry-room, and baseboard heaters totaling 2500 watts in the office. This made a total of 50.3 kw connected heating

NEW ADDITION to old church provided 3720 sq ft of floor space which was heated electrically by unit ventilators, convector units and baseboard units.

*From a paper presented by Rev. Burton at the Fourth *Electrical World* Conference on Electric Comfort Heating and Heat Pumps, St. Louis, Mo., October, 1959.

CONVECTOR UNITS rated at 3 kw were installed in each of three vestibules to make up loss of heat through frequent use of the doors.

UNIT VENTILATORS along one wall of sanctuary draw fresh air from outdoors, heat it, and direct it upward to counteract down-draft from windows. Room air is taken in through louvers at base of unit and recirculated.

BASEBOARD UNITS totaling 14 kw were used in the sanctuary, baby cry-room and office.

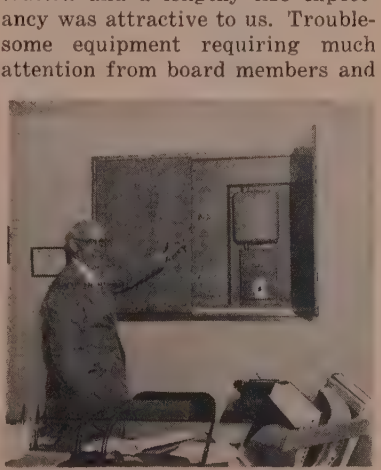
load on our 400-amp, single-phase service.

I am most happy to report that our first year's operation has run under the estimates of both the heating manufacturer and our local utility. We have used a total of 26,720 kwhr from September 22, 1958, through September 22, 1959. Maximum demand was 46 kw, with a total of about 65 kw connected. The above figures include not only the heating equipment consumption, but that of the lighting for both old and new buildings and power for a coal-stoker furnace in the old building, an 80-gallon water heater for the baptistry, a kitchen range, and a water pump for the church and parsonage. Our power rate after the first 600 kwhr is 1.7 cents per kwhr.

(3) *The added burden on our custodial help* had to be kept to a minimum. We were almost doubling the amount of floor space over that which we had in the old building. The ease of operation, cleanliness, and freedom from smoke, soot and ashes which would go along with electric heat meant a minimum increase in labor. For a church that needed, and could afford, only part-time custodial service, this was important.

Time-clock operation is a labor-saver and reliever of responsibility. On Sunday morning the clock, all by itself, switches from the 55-degree week-day thermostat setting to the 70-degree setting to prepare for Bible School. This is done about two hours ahead of time to allow building surfaces and furniture to warm up. Twelve thermostats insure a uniform building temperature—no hot or cold spots anywhere. We do not have a blast of hot air or, the distraction of blowers shutting off and coming on again. After services are over, the thermostats again convert to the 55-degree setting until about an hour before the evening service. For any special service during the week, a manual timer is turned with a flick of the wrist to turn on the heat, and it will automatically turn the heat off at the end of the time desired. The church office is heated full time, independent of the time-clock operation—another convenience easily arranged with electric heat.

(4) *Anticipated trouble-free operation* and a lengthy life expectancy was attractive to us. Troublesome equipment requiring much attention from board members and trustees is an aggravation to be avoided. To date we have had no trouble with the equipment; it has performed satisfactorily. The only complaint we have had all year involved a slight draft caused by exposed beams of the rather low ceiling directing the intake air downward. We have received counsel and have taken steps to correct this problem.



"BOILER ROOM" of church, located on office wall, contains all circuit control and protective equipment. Timer at lower right permits manual operation of heaters for unscheduled meetings or services during the week.

(5) *Fresh air* available from the electric unit ventilators keeps people from going to sleep during the sermon. A comfortable heat at the beginning of services in our old sanctuary invariably became excessive and stuffy with 200 crowded people, resulting in nodding parishioners. Of course they could have helped the situation by firing the preacher and hiring one more interesting, but the use of the schoolroom ventilators provided a promise of relief more to my liking. The added insulation and sealed double-glass windows have also aided in keeping out the summer heat.

(6) *The pioneering spirit* accompanying the idea of electric heat for church use—the thrill of something new and different—entered into our decision. However, this was not a major influencing factor; I would consider our board members to be good, conservative business men.

Yes, we studied, investigated, perspired, asked questions, listened, read and prayed—then we went electric. We held our breath until the wisdom or foolishness of that choice would be in evidence. We no longer hold our breath. We are happy because we chose as we did.

VIEWED FROM TOP of adjacent Bay View Hill, Candlestick Park is pictured while first leg of first lighting tower (in outfield) is being raised into position. Over 2½-million cu yds of earth were carved from hillside to provide bowl-shaped site for 45,000-seat municipal stadium. Earth so removed was then used to create 60-acre parking area on former tidelands. Cost of stadium and site exceeded $11 million.

Giant Highlights

Banks of 1500-watt floodlights, mounted 200 ft or more above the playing field and remotely controlled through contactors, illuminate San Francisco's ultra-modern baseball stadium. Designed by consulting engineer Lyle E. Patton in collaboration with architect John S. Bolles, these impressive facilities were installed by the Brayer Electric Co.

By Hugh P. Scott

COINCIDENT with the opening of the 1960 baseball season, a beautiful new stadium in San Francisco is being dedicated as the home field for the transplanted National League Giants. Overlooking the bay at Candlestick Point, this 45,000-seat park incorporates up-to-the-minute concepts regarding spectator comfort and convenience. In fact, even after initial plans had been formalized, changes in design were still being made in order to keep the overall plan as progressively modern as possible.

Several of these alterations were of major proportions, as, for example, relocation and redesign of the four largest lighting towers in order to permit unobstructed viewing of the playing field from all seats in the upper deck.

As initially designed, these four towers surmounted the front lip of a cantilevered windbreak that curves forward over the upper six rows of seats, tower bases then continuing straight downward to obtain required support from the lower structure. This feature would have obstructed the view of relatively few spectators, yet it was decided to eliminate the possibility completely by shifting towers back behind the stadium's outer periphery.

This was a far-reaching decision for, without the stadium and windbreak as the basic support, it became necessary to design and construct free-standing towers supported by concrete shoulders projecting rearward from the stadium at much lower elevations. Then, since the forward lip of the windbreak would now create an objectionable cut-off shield for lighting patterns (provided that lights were kept at initially designed heights) it was evident that towers would have to be higher than originally planned. This also had a related problem because, with lights placed higher and further back from the playing field, it became necessary to increase the number of luminaires in order to obtain prescribed levels of illumination on the infield.

This progressive series of changes was costly, yet it emphasizes the fact that spectator enjoyment and structural beauty were basic considerations of design.

Another provision for spectator comfort is the installation of radiant heating in deck-slabs so that feet will remain warm on cool summer evenings, or during fall and early winter if the stadium is subsequently used for football.

Radiant heating is likewise provided for players, 3-position switches on dugout walls being provided to turn on either one or two 800-watt heating cables contained in slabs beneath the benches.

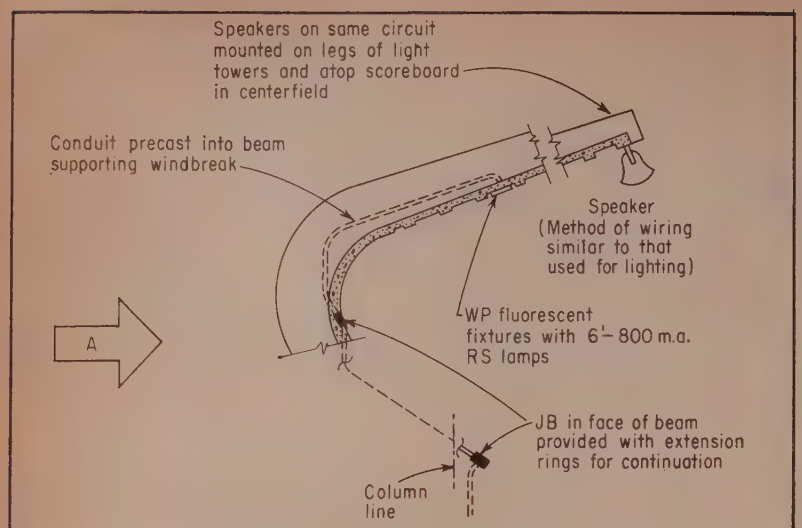
Also found in dugouts are dimmer controls to regulate lighting intensities of recessed ceiling fixtures.

FIRST-LIGHT TRYOUT found illumination intensities and evenness of distribution fully meeting specifications and design criteria. Unlighted scoreboard may be seen behind center-field bleachers. Free-standing lighting towers located behind upper deck of grandstand are believed to be tallest in country. Largest bank of lights (behind first base) contains 230 1500-watt luminaires.

DUE TO HEIGHT (200 ft) and weight (15 tons) of some of the taller towers, hollow square legs were shipped from Weld-Rite mill to stadium site on five flatcars in tandem, then spray-painted after arrival. Note feeder cables already pulled into towers; also rugged reinforced construction of baseplates.

ON-THE-JOB WELDING also included beading of handhole plates. Rungs seen on top of leg provide access to tower tops for relamping, aiming and cleaning of floodlights, although installation of power hoists and bosun chairs are a future possibility to speed and ease these maintenance chores.

TOWER LEGS WERE HOISTED into approximate position by giant boom crane, then pre-drilled holes in thick steel baseplates were aligned over anchor bolts by means of guy cables radiating in several directions to bull sheaves or power winches. Note cone-shaped centering caps on tops of bolts beneath tower base.



WINDBREAK (A), curving over last six rows of seats of upper level, carries series of loudspeakers in forward lip and weatherproof fluorescent lighting units between fins of precast concrete shell. (B) Free-standing light towers behind windbreak are supported by cantilevered steps positioned 35 ft above the playing field, with feeder conduits extending to distribution sections of adjacent substations.

ONE OF THE TALLEST TOWERS, rising more than 190 ft in free-standing height, is supported by a reinforced-concrete shoulder protruding from rear of double-deck section of stadium. Initial design had towers located on front lip of overhanging windbreak, with tower legs continuing straight downward to obtain necessary support. By shifting towers behind stands, as here shown, unobstructed view of playing field is obtained.

Accommodating radio, TV and press facilities, 80 open-front booths designed for that purpose (and extending from first to third base by way of home plate) are located beneath the forward edge of the upper stands. These booths are equipped with power receptacles, vaporproof RS fluorescent lighting, telephone jacks and cable trays for movie and video cabling. Since each booth seats six people (providing a total capacity for 480), ample space is provided for "the fourth estate" as well as for special guests in these "luxury" class boxes. Access to this Press Row is via bridge passageways extending from the promenade concourse and (planned for the future) by elevators rising from main and player-clubhouse levels. Completing the press facilities on the mezzanine level are photo labs and storage rooms, also a lounge and press room equipped with telephoto, teletype and all similarly required services.

On this same level are located executive offices, lobbies, dressing rooms and lockers for venders and usherettes, likewise a future clubhouse, bar and 800-seat restaurant for box owners. Each of these separate areas is provided with special lighting treatments, air conditioning, electric heating, and power facilities dictated by specific functions and desired decor.

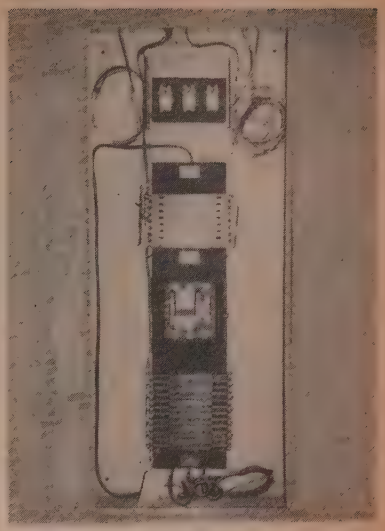
Also at mezzanine (and other) levels are well-illuminated and electrically serviced concession and vending booths, police and first-aid stations.

Returning to the subject of field lighting, towers are variously 2- and 3-legged square cross-section double-taper structures (widest at midpoints) with from four to six rows of 1500-watt incandescent floodlights atop each assembly. At present there are 1147 such lights, although mounting and circuiting provisions will permit the addition of more units if future lighting intensities are to be increased.

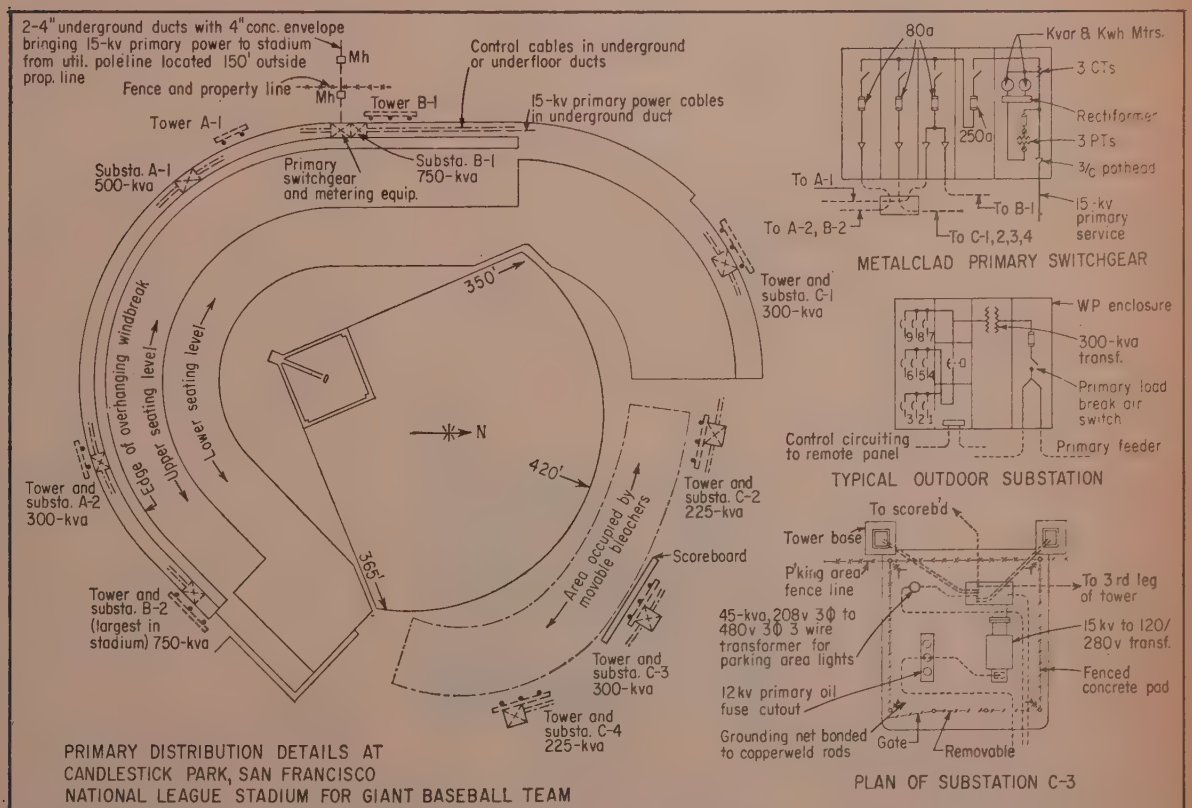
Tallest tower is 196 ft in height, and, since this tower is supported by a concrete step cantilevered from the stadium structure nearly 40 ft above ground, the elevation of upper lights is 232 ft above the surface of the playing field, believed to be the tallest free-standing sports-lighting tower constructed to date. This tower also supports the longest catwalk truss (75 ft) and the greatest number of floodlights (230), which are controlled through 52 circuits radiating from seven weatherproof panels mounted directly behind the lights. Of this total, 226 are 110-volt lights, used solely for field illumination and, since they are operated at 10% over-voltage, lumen output is boosted approximately 37% above listed ratings. The remaining four floodlights on the tower, containing standard 120-volt lamps, are used to provide general (minimum) illumination when field-floods are not lighted, two 1000-watt luminaires with 32-degrees beam

CATWALK TRUSSES, some as long as 75 ft, were equipped with lights and distribution panels at ground level, then were hoisted into position where supporting brackets (the vertical legs seen beneath the front edge) were bolted against tower tops. All electrical components were installed on bare truss structures; then reflectors and panels were enclosed by paint-proof coverings before spraying with red-lead base ond finishing coats.

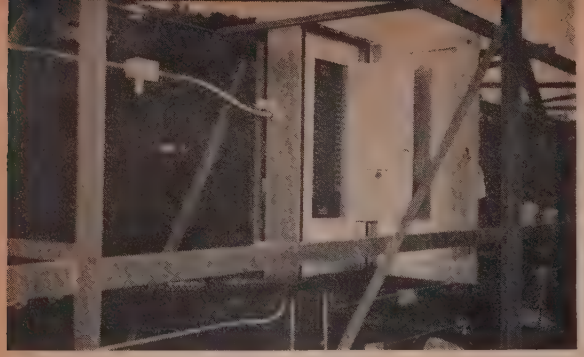
MERCURY VAPOR floodlights on tapered steel poles illuminate 60-acre parking lot having capacity for over 8000 cars. Due to rectangular housings and butterfly design of reflectors, broad patterns of even light can be projected. Overhanging canopies eliminate upward spill light, a safety precaution dictated by nearness of the San Francisco airport. Fixtures dissipate heat readily and resist shock and vibration.



LOCAL CONTROL PANEL shows utilization of electrically operated mechanically held remote control switches (at top) for regulating lighting in seating and concession areas from central engineer's station. Contactors are supported by extended bus plates that also constitute electrical connections for units. Control is by momentary contact, opening and closing buttons being electrically interlocked to prevent simultaneous depression.



CANDLESTICK PARK, pear-shaped reinforced-concrete contemporary stadium, is illuminated by eight towers supporting total of 1147 1500-watt floodlights mounted approximately 223 ft above playing field. Primary power at 12-kv is distributed through underground ducts to eight local substations located adjacent to towers. There transformers step current to 120/208 volts for floodlighting, scoreboard operation and general stadium use; also to 480 volts for parking areas.



WEATHERPROOF PANELS are secured to tower trusses by lugs which are welded to cabinets and bolted to truss framework. Hinged door of cabinet is neoprene-gasketed.

LOCAL SUBSTATION, one of eight, is concrete-pad-mounted adjacent to outfield lighting tower, large illuminated scoreboard and one of several parking-area load-centers.

spreads directed toward the lower stands, and two 1500-watt floods with 75-degree beams focused on adjacent parking areas. Circuiting and arrangement of lights on the other seven towers are approximately similar.

Types of luminaires, distribution patterns and aiming details were naturally dictated by number and location of towers, number of luminaires being installed and mounting heights. Initial aiming of luminaires was established at ground level. Then, with lamps preinstalled in reflectors, trusses were hoisted into position and bolted to tower tops. After night-time results on all sections of the field had been checked for glare and uniformity of lighting intensities, minor readjustments were made by men working aloft.

At the present time, access to upper catwalks (for relamping, cleaning and focusing) is accomplished "the hard way"— by climbing, although motorized bosun chairs are "on the books" for future consideration.

Turning lights on is accomplished progressively by towers, activation of contactors in local control panels being initiated from a remote supervisory station containing step controllers.

Eight Substations

As noted on the accompanying plot plan, a separate substation is located adjacent to each of the eight lighting towers, these stations varying in size from 750 to 225 kva. Power at 12 kv is delivered to these stations through underground ducts radiating from a primary switchgear center (located at substation B-1), this primary metal-clad assembly obtaining dual underground utility service at the same 12-kv level from two separate utility overhead lines and stations.

At all substations, power is transformed to 120/208 volts for field lighting, scoreboard operation and general stadium use, then is stepped up to 480 volts 3-phase 3-wire through separate 45-kva transformers for mercury-vapor lighting of adjacent parking areas.

Due to the unusual height of tower legs, these components were shipped to the stadium site on five flatcars equipped with two widely spaced pivot points. Upon arrival, they were raised into approximate position by a 100-ton 175-ft-high boom crane; jockeyed into exact position by means of guy cables extending from bases in several directions and powered by truck-mounted winches; eased down over 2-in. anchor bolts embedded in reinforced-concrete foundations; then secured to collar-reinforced steel bedplates by means of double locknuts.

Catwalk trusses, with all reflectors, panels, conduit and wiring pre-installed, were then raised by motorized hoists, cables running over sheaves attached to gallows brackets overhanging each tower, with final bolted connections completed by men working "topside."

TOWERS WERE PLUMBED over 2-in. anchor bolts, then were snubbed tight against both tops and bottoms of baseplates by double locknuts. Feeders for towers, conduit-contained in deep reinforced-concrete foundations, extend to substations located adjacent to each of the eight lighting standards.

Since all floodlighting feeders were pulled through the hollow towers prior to erection of same, the connection of upper feeder terminals to elevated control panels and lower terminals to foundation-contained substation leads was a relatively minor operation.

To quote one "old-timer" who attended the "first-light" ceremonies, "We've come a long way since so-called 'night baseball' came into being three decades ago and white-washed dishpans served as reflectors for 500-watt clear lamps."

Mercury-Vapor Parking Lights

In the adjacent 60-acre parking area (providing capacity for 8200 private cars, plus hundreds of chartered buses), illumination is furnished by mercury-vapor lighting units mounted in multiples of four atop tapered steel poles. Due to the butterfly-reflector design of these rectangular luminaires, wide-angle large-area illumination is possible while glare and shadows are at a minimum. Also, since finned cast-aluminum housings readily dissipate heat, tempered glass lens plates resist shock and special grip-type lamp receptacles resist vibration and virtually insure lamps against breakage, these lighting units are considered ideally suited for this particular geographical region where high winds and earth tremors are distinct possibilities.

Credit for the electrical designing belongs to consulting engineer Lyle E. Patton, who coordinated his proposals with stadium plans prepared by architect John S. Bolles. Installation of lighting, control, switchgear and substations was by the George F. Brayer Electric Co. Charles L. Harney was general contractor.

Electrical Details In 460/265 Distribution

A look at some of the design and construction techniques selected for the 460Y/265-volt distribution system used in a modern New York City office building.

OPEN-TYPE SWITCHBOARD is used for each of the four supply feeders to the building from the 460Y/265-volt spot network bus in the utility vault. Current-limiting fuses are used in all main and feeder switches, providing fast interruption of faults with effective reduction of let-through energy capabilities. And use of different sizes of fuses of the same operating characteristics provides selective coordination through the system: on a given fault, the smallest fuse in series with the source and fault will open before larger ones in the same series circuit. Selection of open-type switchboards was based on engineering analysis. The design engineer preferred custom-designed boards of the open type to assure full-capacity for the heavy continuous loads, substantial bracing of bus for the extreme short-circuit duties, effective ventilation for cool operation and ready adaptability to change. The boards are installed in a locked area, accessible only to qualified personnel. [However, the N. Y. City code no longer permits the use of open type switchboards on systems operating above 150 volts to ground.] On these boards, all switches rated above 1200 amps are bolted pressure switches with a capability for load interruption—although these are not quick-make-quick-break types and can be "teased" open. Switches of lower rating are simply knife-type switches and were chosen for application as isolating switches. It was not design intention that such switches have load-break ability. As an alternative, complete and effective load-break switching is provided at each and every local tap location. The main switchboards are essentially automatic disconnect centers through the use of the fuses which are capable of clearing any fault conditions.

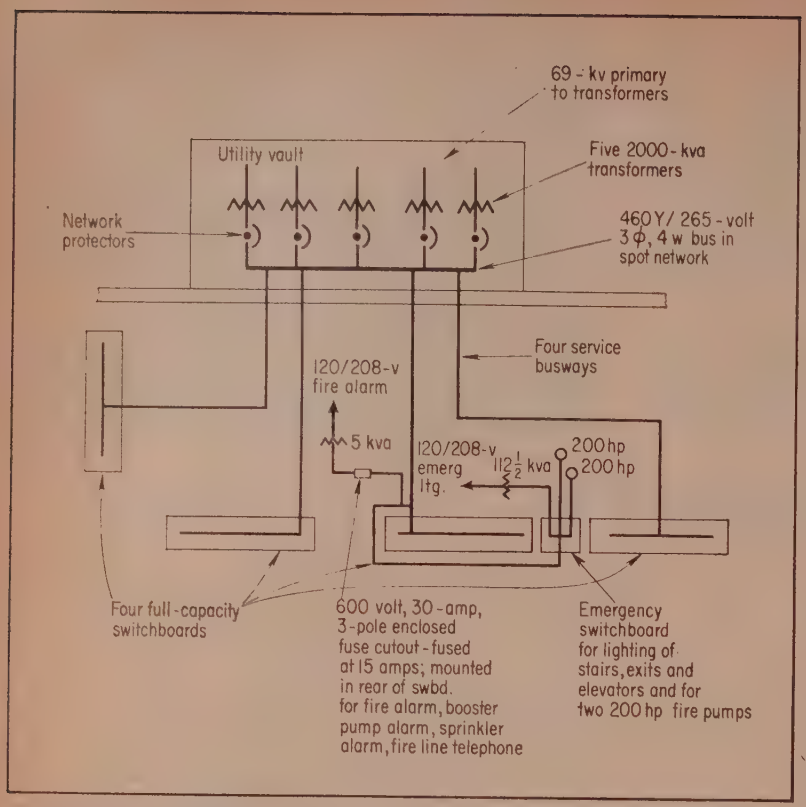
ONE of the early 460/265-volt electrical distribution systems in New York City serves 666 Fifth Avenue, a 42-story, aluminum-clad skyscraper commonly known as The Tishman Building. All distribution runs on the load side of the main switchboard are 600-volt conductors installed in rigid conduit. The installation includes step-down transformers to 120/208-volt distribution. The electrical distribution system was designed by Eitingon & Schlossberg Associates, electrical engineers. Installation was made by Arc Electrical Construction Co.

Lying behind the decision to put the system in rigid conduit were several engineering considerations. Chief among them was a factor that demonstrates how electrical distribution systems are inevitably tied up with, and conditioned by, the requirements of a building's purposes.

Like many other buildings, the Tishman Building was designed and constructed before it was known whom all its tenants would be. There was therefore little basis for determining the ultimate electrical demands that would develop, even though it was anticipated that these demands would grow. A well-programmed conduit installation remains clear cut as the electrical load grows: you put in what you need now, provide space for the future and add as necessary in accordance with the established program. As an example of such planning, 14 lighting risers were provided in the Tishman Building for initially anticipated loads, and sleeves were installed in the floor slabs of the electric closets to take care of five future riser conduits.

Second was the consideration that a conduit installation reduces the distance to which short circuit problems extend into the building from the service. Breaking the load into the smaller feeders inherent in a conduit-and-cable distribution system introduces more impedance between distribution point and final branch circuit overcurrent protective devices, thereby reducing the size of the short circuits which these final overcurrent protective devices must handle, while total impedance and consequent distribution system losses introduced by breakup into small feeders is not appreciably increased for the overall project.

Finally, in a conduit installation, electrical faults are localized to

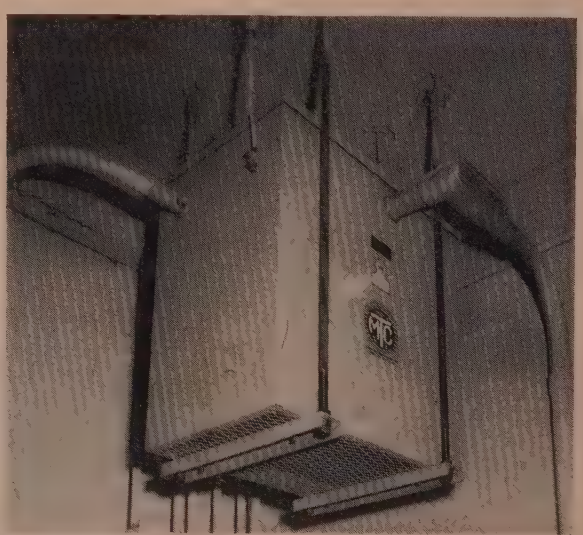


SWITCHBOARD HOOKUP consists of four full-capacity (5000-amp) boards and one low-capacity emergency switchboard tapped from the supply side of one board. Other emergency tap is made as shown for fire alarm system. Emergency switchboard and fire alarm circuit are tapped from the load side of metering CT's for the one main switchboard.

relatively small portions of the distribution system: repairs can be made quickly, with little interruption of service. There are few electrical faults that could possibly occur in conductors housed in rigid conduit that could not be corrected overnight.

Of particular interest at 666 Fifth Avenue are the main switchboards, five in number, designed especially to handle, in the most economical manner possible, the heavy normal current and the severe short-circuit conditions which might be encountered at this project. They are live front type, supplying 460/265-volt, 3-phase, 4-wire current. Both service and feeder switches rated over 1200 amps are knife-type bolted pressure silver contact. They are live front, back connected, provided with blade locks to prevent the switch from opening under short-circuit stresses. Switches rated 1200 amps and less are 500-volt, single throw, knife blade, type A construction. Overcurrent protection is provided by coordinated application of current-limiting fuses throughout the 460/265-volt system. Beyond the step-down transformers all switches are equipped with non-current-limiting type fuses.

FEEDER CONDUITS are trapeze-racked in one of several group runs from main switchboards in background, to point of vertical rise through building's electric closets. The enclosed spacious and well-lighted access area can be seen behind the switchboard in background. Meters and switches for store tenants are on wall at left in photo. Entire building uses conduit type distribution with plenty of spare capacity.



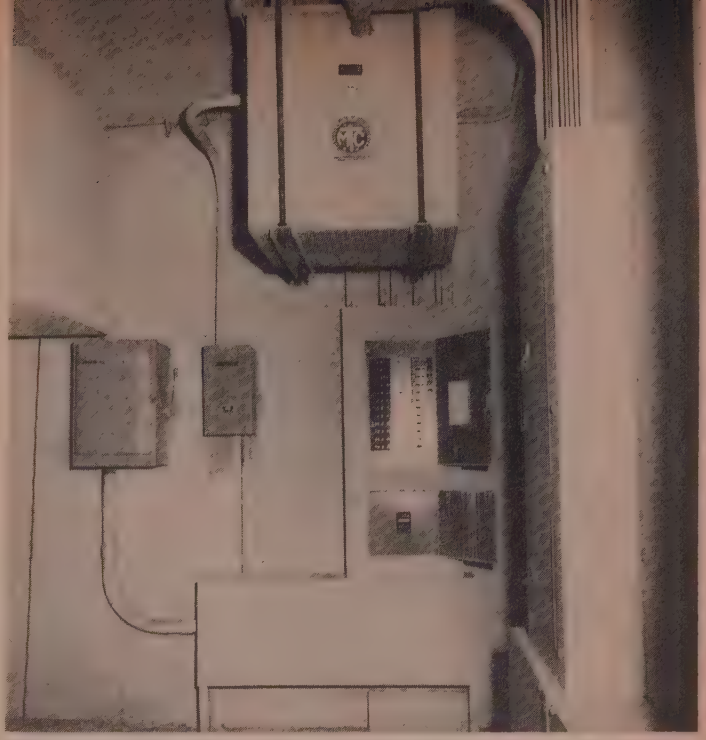
SECONDARY GROUNDING of each 480-120/208-volt step-down transformer in the system is made by an insulated conductor run from an external grounding lug on the transformer case to building steel in the slab above. The conductor is welded to a copper plate which is welded to the steel. As shown, the conductor is run in conduit into the slab. The lug on the transformer frame is internally connected to the secondary neutral. In this way, the quickest and most effective ground return path is provided for secondary side faults. And another point of equipment ground is made for the conduit and enclosure system at each such transformer installation. Primary conduit (at left) is the basic equipment ground.

The panels that support switches and current-limiting fuses are of high grade ebony asbestos, 1½ in. thick, and beveled on all face edges. They are mounted on an angle iron frame, neatly arranged in rows in the big basement switchboard room. They stand 6 ft from walls and have more than 6 ft clearance of the ceiling. Thus, fully in the open, well ventilated, accessible for repairs, the switchboards can be walked around. Access to the rear of the switchboards is protected with heavy wire mesh screens; rubber mats run the length of the floor in front of them.

The utility furnished, installed and connected five 2000-kva transformers in sub-sidewalk vaults. These transformers, supplied with 69,000 volts on their primary sides, were connected on the secondary side through network protectors onto a 460/265-volt bus, thereby forming the conventional spot network arrangement which the utility provides as a standard for buildings accepting the 460/265-volt characteristics as the incoming service. Vault space for a sixth transformer was provided to allow for a future increase in capacity.

In addition to the use of current-limiting fuses as a means of reducing the hazards presented by the high short-circuit capabilities of the utility service, the engineers designed special high-reactance bus duct connections between the service take-offs and the main switchboard. These bus duct connections were figured to introduce the minimum possible value of resistance in conjunction with the desired amount of reactance, thereby causing minimal voltage drop and power losses under normal conditions, while imposing suitable limitations on short-circuit currents.

These connections from take-off stabs to switchboards each consist of single, 6-in. by 6-in. by ¼-in., ventilated, square cross-section, copper tube bus per phase and two, 6-in. by ¼-in., flat, copper bars for the neutral. Phase buses are spaced 17 in. on centers; neutrals are spaced 6 in. on center from the end phase bus. Each bus connection is enclosed in aluminum busway to prevent heating due to induction and hysteresis. Busbars are braced to withstand the short-circuit stresses produced by 200,000 amps RMS symmetrical. Pull boxes are mounted on top of the switchboard and extend back to the walls.



TYPICAL ELECTRIC CLOSET in the building is arranged with feeder tap pull box in riser runs (at left), with fused safety switch protecting tap conductors into wiring gutter. From gutter, 3-phase, 4-wire, 460Y/265-volt lighting panel is fed through a main CB (in center of photo), and supply is made through a wall-mounted CB to the ceiling suspended 480-120/208-volt, dry-type transformer. The transformer secondary is then brought down to supply the 120/208-volt lighting panel, on the wall at right, which is fed from a gutter below it and through a main CB. Both panelboards have CBs for branch circuits. With this layout, each load group—transformer and each panel—is provided with individual disconnect and overcurrent protection in the CB units. The fused switch contains current-limiting fuses to back up the various subfeed and branch circuit CBs on heavy shorts. This is necessary where the available short-circuit current at the point of application of the CBs is in excess of the interrupting capacity of the CBs. Here, the fuses will act faster on any such shorts to clear the fault condition. The fuses are sized small enough to provide effective protection but large enough to eliminate nuisance operation.

Main feeder cables are connected at the back of switches and rise into the pull boxes where they enter the rigid conduit riser installation. The cables leaving outgoing lugs on the main switchboard are asbestos sleeved for arc containment. The 3-phase legs and associated neutral are laced together with twine. In each case the whole assembly of cables is painted with silicate of soda (water glass) to seal against moisture.

Electrical services of the Tishman Building are rent-included except for the store tenants occupying spaces on the first and basement floors. The entire electrical load of the building is therefore metered through a set of owner's meters. Service for store tenant's metering is established by tapping a 460/265-volt, 3-phase bussed wiring trough extending unmetered from the switchboard and having concentric knockouts on 2-ft centers for conduit tap connections.

Provision for possible change of the rent-inclusion feature has been made by separating tenant lighting and appliance feeders from all others so that they could be run unmetered to tenants' floors.

Thirty-nine 350 to 500 MCM type RH riser conductors extend up in rigid conduit through electric closets in which are located dry type 3-phase transformers that step down from 460 volts to 120/208-volt, 3-phase to take care of tenant's and owner's incandescent lighting and appliance supply. Transformers are typically suspended from structural slab above by means of trapeze type hangers. From the first to the ninth floors there are three closets per floor; to the eleventh floor, there are two per floor; and to the 39th floor there is one per floor.

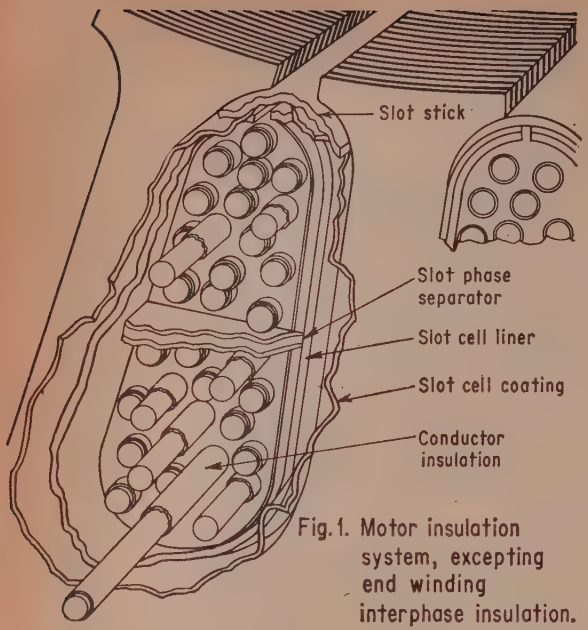


Fig. 1. Motor insulation system, excepting end winding interphase insulation.

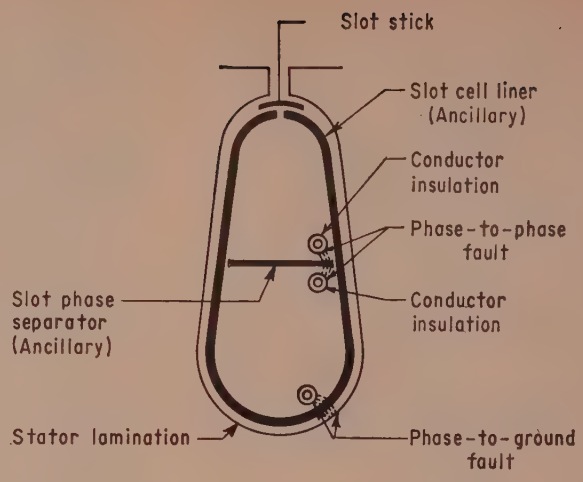


Fig. 2. Phase-to-phase and phase-to-ground faults.

"Tailoring" Motor Rewinds

A step-by-step outline of the major causes, characteristics and treatments of motor insulation failures—to aid in making rewound motors better than the originals which failed.

By John Molnar, *Consulting Engineer, Moorestown, N. J.*

A MOTOR rewind shop is usually concerned with replacing the faulty winding turn-for-turn and wire size-for-size. This then results in a motor with electrical characteristics — horsepower, torque, speed—identical to the original. But the performance limitation of the newly rewound motor always rests primarily with the insulation. Therefore, since many new and improved insulating materials are available, it is in this area that rewind shops find widest latitude for "tailoring" to environmental conditions.

The insulating materials used in electric motors may be divided into three well-defined categories (see Fig. 1):

1. Conductor insulation
2. Ancillary insulation
3. Impregnating insulation

Conductor Insulation

Conductor insulation is the coating laid down directly upon the conductor and is designed simply to insulate adjacent conductors from each other. These materials include resinous coatings, oleoresinous films, synthetic yarns, glass, asbestos, and ceramic products.

Ancillary Insulation

Ancillary (auxiliary) insulation includes slot cell liner, slot phase separator and end winding interphase insulation. This category also includes all materials designed to distribute a uniform coating over the entire interior surface of the slot cell.

Impregnating Insulation

Impregnating insulation includes air-drying and thermosetting-type varnishes, polyesters, silicone resins, polyvinyls, epoxies, and epoxy alkyds. Vacuum-pressure impregnation in combination with dipping of the complete stator is gaining widespread acceptance in large well-equipped shops. Epoxy encapsulation is now possible with average rewind facilities.

To be suitable for general use, insulating material must meet basic chemical, electrical, mechanical and thermal requirements:

1. Chemically, it must withstand moisture, oils, mild acids and alkalies.

2. Electrically, it must have high dielectric strength.

3. Mechanically, it must be strong, pliable and withstand vibration and magnetic stresses.

4. Thermally, it must withstand established operating temperature.

But to meet the needs of specific installations the predominant characteristics of insulating materials must be judiciously selected and properly combined. Economic justification is always a limiting factor.

Defining Burnouts

A motor rewind shop exists only because there are motor burnouts, and motor burnouts occur only because of insulation failure. Therefore, for any shop to be able to properly "tailor" rewinds, records of insulation failure must be kept.

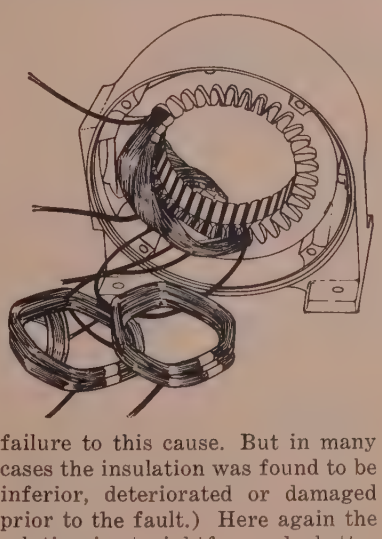
There are three basic types of insulation failures (see Fig. 2):

1. Total burnout
2. Phase-to-phase
3. Phase-to-ground

Total Burnout—Total burnout is a failure in which the entire stator winding insulation shows signs of excessive heat by causing the insulation to become brittle and discolored and to eventually fail either phase-to-phase or phase-to-ground. This type of failure is the result of prolonged overload, extreme duty cycle or excessive ambient temperature. A check on ambient conditions will either verify or disprove the need for Class H type of insulation. Extreme duty cycle can be determined by observation of the operation; here again Class H is indicated. If neither case is apparent, the motor overload protection did not function for any one of many possible reasons—improperly sized overload relay heater, defective overload relay, etc. This, of course, does not fall within the jurisdiction of the rewind shop but is the responsibility of plant electricians. In passing, the importance of properly sized overload relay heaters and effective overload relays cannot be over-emphasized as many unnecessary motor failures can be traced to defective overload relays.

Phase-to-Phase—Such failures can occur in two different areas: 1. in the stator slot across the slot phase separator; 2. external to the stator laminations in the end winding area, across the end winding interphase insulation. At times, slot failures are difficult to determine; but every effort should be made to establish the exact area of fault. In either case, the solution is clear: better phase-separator insulation.

Phase-to-ground—These failures, in a properly wound motor, will always occur phase-to-stator-laminations. (There are records of phase-to-end-bell and phase-to-housing failures; but these are the result of improperly wound motors, as conductors should never touch the end bell or housing.) Phase-to-ground failures are caused by inferior, deteriorated or damaged slot cell liners. (Much has been written on destructive transient overvoltages on ungrounded systems developed by repeated restriking of arcs of a line-to-reground fault, and many have attributed insulation



failure to this cause. But in many cases the insulation was found to be inferior, deteriorated or damaged prior to the fault.) Here again the solution is straightforward—better slot cell liner.

Causes of Failures

There are three main categories into which all causes of insulation failures can be grouped:

1. Moisture
2. Heat
3. Chemicals

Moisture causes most damage to open and drip-proof motors. Therefore, in wet areas, totally-enclosed frames are recommended even though the totally-enclosed motor is not completely invulnerable to moisture. First, water can follow the shaft into the housing. Second, condensation can form inside the housing. In either case, moisture is present to do damage. In some cases, small (¼ in.) holes are recommended for the stator housing at the lowest point to permit this water to drain.

Heat can be caused by excessive ambient temperature and extreme duty cycle. (Prolonged overload excluded, as here the prevailing conditions should be corrected.)

Chemicals include oils, mild acids and alkalies, etc. Here conditions are similar to those listed under moisture except more severe.

"Tailoring" the Rewind

At this point, the causes of failures should have been determined and catalogued or the problem area spotted. It is readily seen from this that all insulation failures can be grouped into two categories:

1. Those in which harmful atmospheric contaminents insidiously destroy the insulation, i.e., moisture and chemicals working from the outside in to the conductor.

2. Those in which heat usually destroys from the inside out.

In the first case, the baking varnish, epoxy encapsulation or "what have you," constitutes a first line of defense. Therefore, if it were possible to successfully seal the conductor and its coating from harmful atmospheric contaminents, these failures would be forever eliminated. But since no such insulating material is available today, a second best will have to suffice.

This second best is epoxy resin encapsulation. This is a process whereby the entire winding is covered with a mixture of epoxy resin and a curing agent. This can be applied by hand in putty form or poured into molds built around windings. Of course, the motor should be wound using compatible type of magnet wire, phase separator and slot cell insulation. A less expensive and much simpler application is the use of epoxy resin solution applied by dipping and baking.

In the second case, as stated earlier, Class H insulation is the solution. It consists of mica, asbestos, fiberglass or similar inorganic materials in built-up form with binding substances composed of silicone compounds. The entire motor insulation system must meet Class H specifications and must be compatible. A word of caution: silicone grease must be used in the ball bearings as it is quite probable that bearing temperatures will be higher than organic lubricants will withstand.

NEW Naval Academy Field House at Annapolis, Md., was designed and built specifically for recreational activities. It provides nearly 3.5 acres of floor area under one roof for indoor, all-weather playing of football, basketball, track, squash, lacrosse, baseball, mass calisthenics.

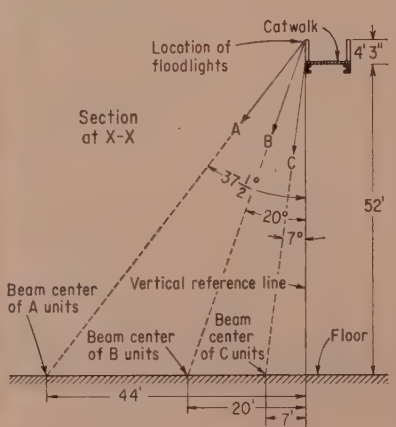
Outdoor Floodlights Solve

Navy Field House Lighting

New Field House at U. S. Naval Academy, Annapolis, Md., is lighted to average level of 30 footcandles throughout, and to 50 footcandles for the basketball court area near one end of the building. Incandescent lamps in outdoor-type floodlights were used.

By Donald R. Brown, *Application Engineering Supervisor*
Illumination Department, Crouse-Hinds Company, Syracuse, N. Y.

CATWALK provides means of access to floodlights for relamping and servicing, also structure on which to mount floodlights. Electric service is provided to each unit by means of flexible cable between floodlight and branch circuits in continuous metal raceway which is installed along the inside of the catwalk railing.



ELEVATION at Section X-X, as shown on the "plan view," gives the details of adjusting the floodlights to provide even illumination over the floor area. B-type units are located opposite the basketball court area only, while A-type and C-type units extend the full length of the catwalks.

THE new Field House at the U. S. Naval Academy, Annapolis, Md., is the first building ever to be constructed at the Academy specifically for recreational purposes. In providing an indoor space large enough to accommodate recreational needs, the architects designed a building which covers nearly 3.5 acres. This building, recently completed, consists of three main divisions; the central section, or Field House proper, and two adjoining wings—one on the north, and one on the south, of the main area.

The design of the lighting for the Field House embraced several problems. These included the lighting of a football field, a portable basketball court, and a running track—all of them indoors, and all under a single roof. The problems embraced not just lighting, of course, but also a system which would permit all

areas to be lighted collectively, or each individually, with further provision that the system be sufficiently versatile to allow variation in brightness according to the needs of each area. These were some of the problems faced by the consulting engineer and the lighting contractor.

In solving these problems and fulfilling the requirements, it was necessary to depart from conventional concepts and procedures.

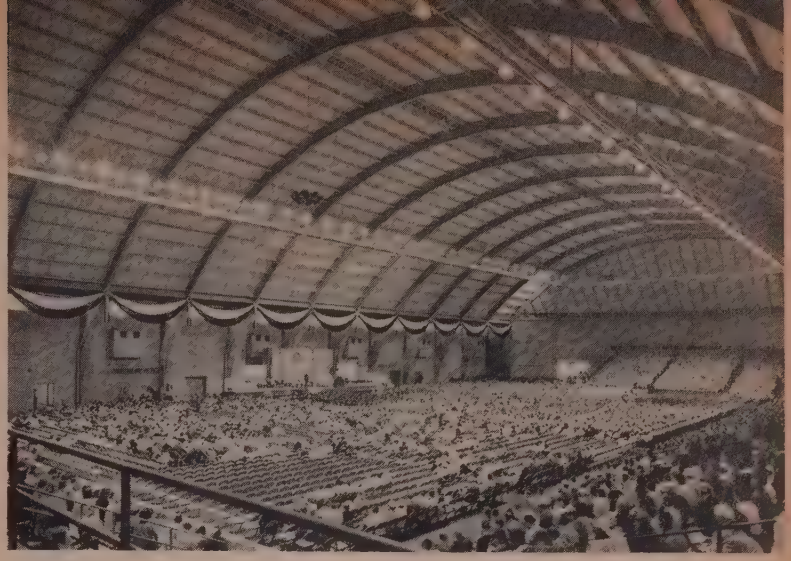
The two wings presented no particular problems for the lighting contractor. The wings are of conventional form and divided into dormitories, dressing rooms, offices, classrooms and similar areas. It was in lighting the central section of the Field House that the electrical contractor was presented with unique opportunities for improvisation.

The Field House proper is 200 ft wide and 370 ft long, or 74,000 sq ft of area under a single arched roof which is 70 ft above the floor at the highest point. Half of this floor area is paved with a bituminous mixture, suitable for basketball, badminton and volley ball. The other half of the floor area is covered with a clay-cork mixture, which provides a surface suitable for football, baseball, lacrosse and soccer. The entire floor area is surrounded by a running track.

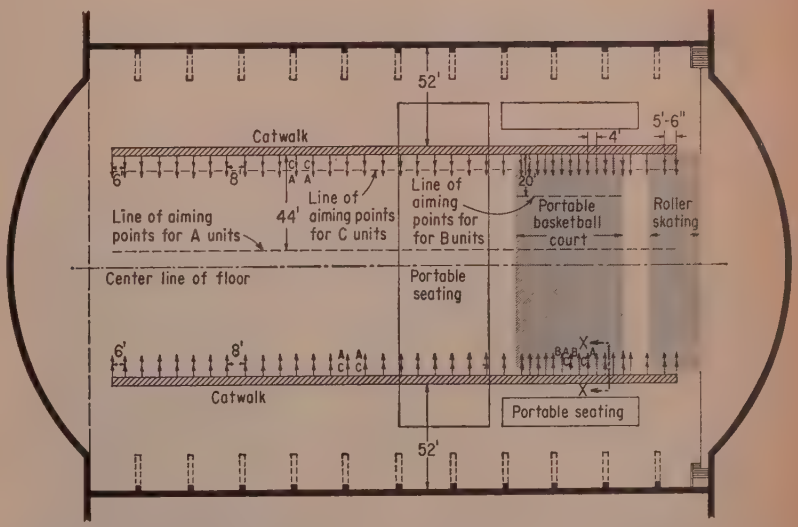
At one end of the floor is a permanent balcony large enough to seat 1,100 people. This, plus additional rollaway and temporary bleachers provides seating for a total of 6,000 people.

The lighting system finally selected and specified by the consulting engineer consisted of lighting units installed along two parallel catwalks, running the length of the building, and provided as a means for servicing the lighting units. Each catwalk is 52 ft in from its side of the building, and 52 ft above floor level. Each catwalk has a guard railing approximately 4 ft high. These and other details are shown in the plan view of the Field House in the accompanying illustration, which also makes it easy to visualize the lighting problem presented.

For example, when the Field House is used for football games, a floor area 160 ft by 300 ft is needed. For this area, the specifications called for 30 footcandles of illumination over the playing field at floor level. On the other hand, for basketball games, a smaller area —about 70 ft by 100 ft—is used and the specified lighting level was higher, or 50 footcandles.



LIGHTING for Field House proper, containing 74,000 sq ft of floor area, is by means of 225-kw of incandescent lamp load, or 1500-watt PS-52 general service lamps in 150 outdoor floodlights, installed in two parallel rows adjacent to ceiling-supported catwalks. Field House may also be used for large meetings, band concerts, etc., as shown here. Field House lighting is used about four hours each day.



PLAN VIEW and lighting layout, including location of portable basketball court, roller skating rink and portable seating. Catwalks are 52 ft above the floor, and ceiling height at center of the arched ceiling is 70 ft.

After considering the problem in all aspects, it became apparent that no existing interior type of luminaires would allow the required versatility and flexibility in lighting control, permit proper aiming, and assure uniform and even illumination. However, it was found that all of the requirements could be met, and all problems satisfactorily solved, by the use of high efficiency outdoor lighting units. Type FLA enclosed Alzak floodlights were selected, and a total of 150 units were used. Each floodlight is lamped with a 1500-watt PS-52 general lighting service lamp. These floodlights each have a wide beam etched reflector which provides an 80-degree beam light spread. The units are also equipped with a heat-tempered clear glass cover.

As shown on the plan view, there are 75 floodlights located along the railing of each of the two catwalks. Floodlights identified as "A" units were installed at the top of the catwalk railings, and floodlights identified as "C" units were installed at

(*Continued on page* 294)

Twin Primary-Selective Secondary System

Powers Science Project

Electrical service continuity was a critically important consideration for the electrical distribution system for the Johns Hopkins Basic Science Building, Baltimore, Md., because of long-term uninterruptable experiments to be conducted in the new facilities.

BASIC SCIENCE BUILDING is newest addition to Johns Hopkins Medical Institutions, Baltimore, Md. It is an 11-story, $5-million structure, will house teaching, research, administrative facilities and lecture halls, and lounge areas for the School of Medicine. Its electrical system was designed by Egli & Gompf, consulting engineers, Baltimore.

SIGNIFICANT installation-cost savings and a guaranteed supply of power, even during emergencies, for important long-term experiments have been provided by the electrical distribution system in the new Basic Science Building of Johns Hopkins Medical Institutions, Baltimore, Md.

The 11-story, $5-million building, which was completed in time to begin the new five-year program in medical education, is the most prominent and impressive of a host of new buildings which are bringing a "new look" to Johns Hopkins. The building houses teaching and research facilities in physiology, pharmacology, microbiology, and physiological chemistry, as well as administrative offices of the famous school of medicine.

The appreciable savings in cost were afforded by a unique bus duct system which distributes power throughout the building. The contractor reports that ease of installing the bus system resulted in saving one-fourth the time previously required for similar installations.

A continuous supply of power is assured through use of special double-ended substations which

provide for transfer of load to an alternate source of power if the first source is lost. Continuous power is vital in the new Basic Science Building to guarantee the success of experiments which may run continuously for months or even years.

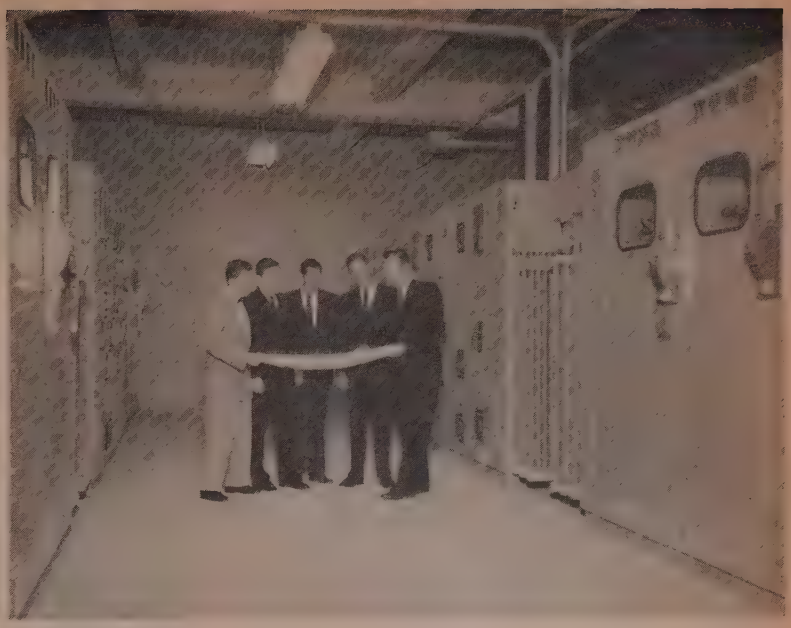
Power for lighting and convenience outlets is supplied from a 2000-kva double-ended substation. Incoming power is 13.2 kv, output is 120/208 volts, 3-phase, 4-wire.

Power for the various services—blowers, fans, pumps, compressors, air conditioning—is supplied from the other substation, identical except that secondary output is 480-277 volts.

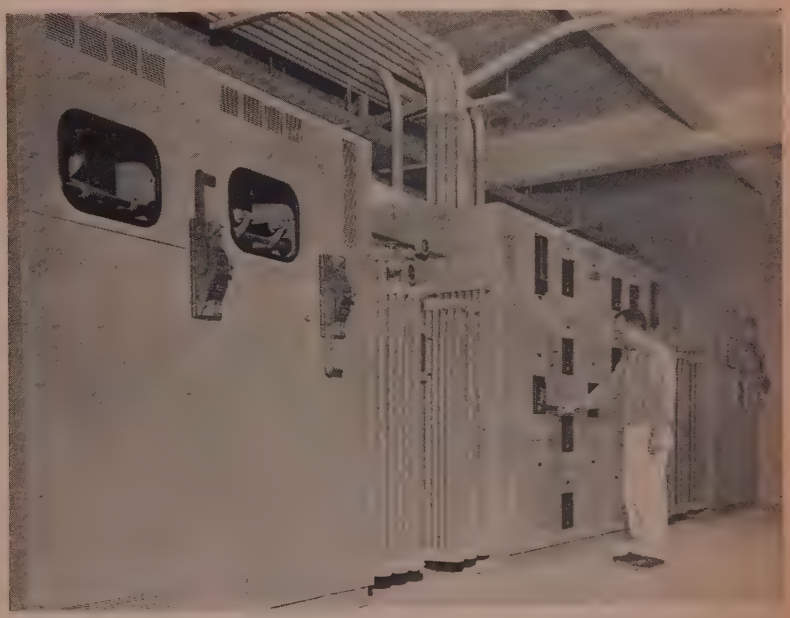
Both substations incorporate a secondary selective system for service continuity, whereby each transformer carries half the load during normal service but can carry all during an emergency. There are two incoming primary cables—normal and emergency—to both substations.

Each substation incorporates four primary interrupter switches, two on each end, two substation transformers and six frames of switchgear. Five frames are for circuit control and protection, the sixth houses 1600-amp tie breaker.

The building power and lighting distribution system stems from decisions made by Egli & Gompf, Baltimore, who were consulting engineers for the project.



DUAL SUBSTATIONS supply all power to the new Basic Science Building. Double-ended unit at left is for services and auxiliaries power, unit at right is for lighting and building power. Electrical installation was made by The Howard P. Foley Co., Baltimore, electrical contractor. Looking over electrical drawings are (l to r): R. J. Van Divender, Fred S. Gates, Jr., Bancroft Foley, Jr., and John L. Korns, all of The H. P. Foley Co., and James C. Schneck, Baltimore district manager of sales for the I-T-E Circuit Breaker Company.



TRIM LAYOUT of switchgear includes (l to r): interrupter switches, transformers, and circuit breakers, followed by identical equipment in reverse listing on other half of substation past the center tie breaker. The project electrical foreman, John L. Nolan, Jr. actuates the breaker's pull-down handle on services and auxiliaries substation.

Distribution System

A system incorporating continuous bus duct risers was selected. Two risers are used; one provides for the ground level and first four floors, the other for the top six floors. The duct runs rise up through special mechanical equipment rooms located on each floor. Also through this shaftway rise all other services for the building, including piping and ducting for heat, water, air conditioning, gases.

After bus duct risers had been selected, the next step was choosing the particular type of duct to be used. Of three types considered; straight plug-in, combination feeder-plug-in, and feeder duct; the straight feeder bus duct was selected.

This type was considered because of its low voltage drop and excellent heat dissipation characteristics. It also allowed taking power from the duct by mounting a circuit breaker distribution panel directly on the duct.

This unique method eliminated running conduit from the duct to a distribution point. Previous methods consisted of making taps to the feeder duct by mounting on it a cable tap box, then running circuits to a separate switch or circuit breaker.

INSTALLATION EASE resulted from the use of circuit breaker distribution panel mounted directly on duct. Riser comes up directly through steel grate flooring, and is mounted to angle iron pieces which are attached to floor flanges Solid copper bus bars connect duct and panel, providing strong mechanical joint to withstand any stresses caused by high fault currents. Power feeds from this location to circuit control centers in the corridor.

1600-AMP TIE breaker can be used to connect two halves of the double-ended substation, to supply continuous power during emergency.

BUS DUCT extends from building power and lighting substation to supply all floors of building through vertical risers located in mechanical equipment shaftways. Two risers are used—one to supply first five floors, the other to supply the top six floors.

Because there is no step-down in voltage between the duct and the distribution panelboard, mounting the panel on the duct proved to be efficient and economical. Eleven such panels were mounted on the two riser ducts in the building. Each contains a main breaker, several branch breakers and space for several future breakers to accommodate expansion.

Another interesting feature is the type of connection between duct and panel. It consists of solid copper bars rather than cable to provide high mechanical strength, which eliminates the possibility of trouble which could occur at this point from the passage of high fault currents.

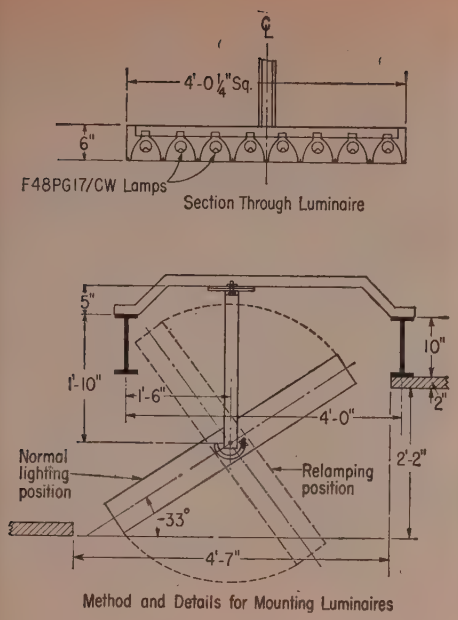
Another unusual feature is the method used to support the bus duct risers. Because other equipment was mounted on the walls surrounding the mechanical equipment rooms on each floor, duct risers had to pass through the floors away from the walls. A very simple and effective mounting was provided by using floor flanges and welded angle iron on both sides of the duct from floor to ceiling. Only one steel structure per floor was required to support both the duct and panel.

Each floor has circuit breaker panels which are supplied from the distribution panelboard in the mechanical equipment room. These, supplying lighting and convenience outlet load throughout each floor, are compact and unobtrusively flush-mounted in corridor walls. The breakers provide both thermal and magnetic actions to shrug off momentary overloads but break quickly, high overloads or short circuits.

The bus duct is designed to carry large currents at minimum power loss and at low operating temperature. It is made of flat, closely spaced, paired-phase bus bars enclosed in a ventilated steel casing and supported by high-dielectric block-type insulators. The Johns Hopkins installation required 350 ft of duct.

The Howard P. Foley Co., Baltimore, was electrical contractor for the project.

CONTROL CENTERS for all branch circuits on each floor are compact, unobtrusive, and flush-mounted in corridor walls. The breakers provide quick identification of all circuits, and easy push-button control. They combine thermal action to handle small momentary overloads, and magnetic action for high overloads and short circuits.



Method and Details for Mounting Luminaires

DETAILS of luminaire and mounting are shown in this drawing. Each luminaire is supported in a steel yoke, which attaches to an iron channel mounted between two 4-in. by 10-in. steel beams located 4 ft apart, center to center.

BORDERLIGHT concealed in ceiling at spectator side of court provides 90 footcandles of uniform lighting over entire playing area for Jai Alai court, at Dania Jai Alai Palace, Dania, Fla. Border consists of 36 fluorescent luminaires, each equipped with eight F48PG17/CW fluorescent lamps. Luminaires are angled at 67 degrees with vertical for maximum light distribution over entire playing area, including the back wall and two end walls.

Dania Palace Uses

Custom Lighting for Jai Alai Court

High lumen output of Power Groove fluorescent lamps is utilized in custom 8-lamp luminaires to provide a lighting level of 90 footcandles over entire Jai Alai court at Dania Jai Alai Palace, Dania, Fla.

JAI ALAI is generally recognized as one of the fastest games in existence. It has been made even faster at the Dania Jai Alai Palace in Dania, Fla., where a new, specially designed fluorescent lighting system was installed recently.

Jai Alai, originated in Spain, is today one of Florida's best attended spectator sports, and is a prime tourist attraction. Like handball, it is played against a wall. But here the similarity ends. A ball—or pelota, to be more exact—is kept moving at lightninglike speed by the impact of long curved baskets, known as cestas. Strapped to the wrists of the players, cestas are used to strike and direct the ball. Action is so swift that the pelota, about three-fourths the size of a baseball, often travels at a speed as high as 150 miles an hour.

The lighting problem is to provide a lighting level sufficiently high to make it possible to see the pelota when it is traveling at such high speeds, and geared to help player's reflexes react faster under such high speed playing conditions. Thus, the lighting objectives outlined by the Dania management for a new lighting system which would replace the old and unsatisfactory system, were simply stated as: 1) keep the illumination level high; and 2) reduce glare to an absolute minimum for maximum spectator and player seeing comfort.

This court was previously lighted by a system of incandescent indus-

(*Continued on page* 276)

A FLEET of 40 service trucks, equipped with steel truck-type shelving, is operated by United Electric Co. of Jacksonville, Fla. All trucks are stocked identically.

STEEL SHELVING simplifies inventory control. Truck inventory card lists location and number of all parts in truck. Inventory time is reduced 75%.

How to Organize Service Truck Stocks

Scrambled tools, material and other equipment, piled into service trucks, lower efficiency and cause poor customer relations. Proper truck-storage bins and adequate inventory forms can solve these problems.

UNLIKE the fabled plumber who always forgets his tools, an electrical serviceman who shows up on a job without the right tools or parts is no joke to the customer. Besides, the inconvenience and wasted time of rummaging through a cluttered truck or returning to the shop cuts into profits.

United Electric Co., Jacksonville, Fla., is one company that realized forgotten or hard-to-find parts can cut profits on a job and harm customer relations. To eliminate these costly evils, this electrical contracting and service firm devised a system for arranging truck space into the equivalent of a small stockroom on wheels.

One of the main reasons for developing the new system was a rapid growth in business volume. Formed only four years ago by Thomas B. Drage, president, and Leland Stewart, vice-president, the company already grosses over $1¼ million a year and ranks as one of the largest electrical firms in the Jacksonville area. It has 110 employees and over 500 regular customers.

Previously, an attempt was made to organize the carrying space in their service trucks. For storing small parts and tools, the firm's mechanics improvised wooden shelves in several trucks. While this

BINS ARE NUMBERED identically in every truck. No matter which truck is used, each serviceman knows exactly where the necessary parts are.

SHELVES KEEP small parts and tools off the floor and leave plenty of room for carrying ladders, tool boxes, cable reels and other bulky items.

helped keep trucks orderly, it was still difficult for a serviceman to find the parts that he needed quickly if he wasn't familiar with each truck. Because each truck had different shelving and a different method of stocking parts, further confusion resulted.

Besides this, the wooden shelving couldn't stand hard service. Riding over rough roads loosened screws and the shelving fell apart. At best, the wooden shelves were a temporary solution.

New Shelf System

Then one day they learned about a new type of steel truck shelving that could solve their problem. This new shelving, made by Penco Division, Alan Wood Steel Co., is designed for service trucks, and consists of low-cost steel-shelving components that come in knocked-down form. After assembling these components, they are installed in each truck as a unit. Because each unit has adjustable shelves and bin dividers, a number of variations can be made in shelf height and width according to need.

United Electric ordered 40 shelving units for their truck fleet. Assembled and installed by their own mechanics, each unit required about 1½ hrs. to complete.

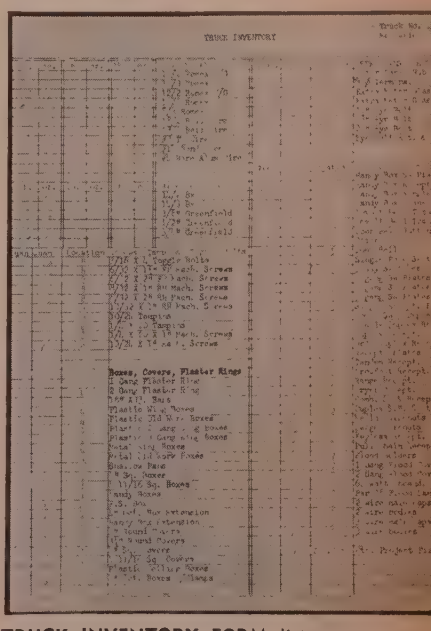
At the same time, a new inventory-control and parts-storage system was also adopted to take full advantage of the new shelving. Bins were numbered to correspond with a truck inventory card that lists the number and type of parts in each truck and their bin location. Another form, called Inventory Charge and Return, corresponds to the truck inventory card, and each serviceman uses it to charge off parts installed on each job. This also insures the replacement of parts to his truck's inventory.

Because this new system cuts inventory time 75%, a complete inventory can be taken every day, instead of each week or month. Also, with this new system, each truck is stocked the same. And, regardless of truck assignments, each serviceman can find parts and equipment at a moment's notice.

Reports from the firm indicate that the major benefit of the new truck shelving is improved customer service. In addition, servicemen spend less time on each job, because all necessary material and equipment are always on hand and easy to find. Besides keeping down the cost of service calls, servicemen can make more calls per day. Also, return trips to the shop for missing items are practically eliminated.

Another plus factor for compact shelving is that more carrying space is available in trucks. Small items stay in the bins, while cable, ladders, tool boxes, fixtures and other equipment lie on the floor.

An orderly system of inventory forms and truck-storage bins can increase profits and improve customer relations.



TRUCK INVENTORY FORM lists quantity and bin location of all items in the truck. Also, this form makes a daily inventory practical.

Electric Heat CAN Cost Less

than conventional estimates indicate.

Solar Electric Heat and Insulation, Salt Lake City, Utah, has reduced heating operating costs to all-time lows using rigid construction specifications, progressive insulating techniques, and a conscientious follow-up. Submetering provides accurate data on validity of estimating methods used.

By W. J. Novak

The bright future of electric heat promises a substantial contribution to the electrical contractor's annual business volume. He is certainly familiar with the electrical equipment and wiring involved; materials and components are standard.

His success may very well be measured by the effort he makes to learn the many facets of electric heat and by the amount of time he is willing to spend assimilating and putting to use available know-how. Each installation, together with a planned follow-up procedure, should contribute valuable heating experience which will improve the quality of his work, reduce costs, instill self-confidence, and enhance his reputation among both past and prospective customers.

This account of one organization covers areas of initiative and investigation open to the designer and installer which may set the pattern for final extension of electric heat to the mass market.

MORE than 800 electrically heated homes showing below-average heating costs have led to the availability of indemnity bonds guaranteeing annual energy usage for all installations made by Solar Electric Heat & Insulation, an installing firm in Salt Lake City, Utah.

An initial desire to learn more about electric heat on the part of Floyd Olson, who heads up Solar, led to the formation first of the Solar Electric Heat Corp. in Utah and Idaho, then the Salt Lake City local firm and, more recently, the Institute of Electric Heating and Insulating, an association of a number of such firms dedicated to furthering the use of dependable, economical electric heat.

Investigation and experimentation in the art of heating and insulating residential structures convinced Olson that conformance to rigid specifications, inspection standards and a conscientious follow-up procedure would result in reliable heating jobs whose operating costs could be predicted accurately and *guaranteed*.

To date, Solar Electric Heat has installed 800 electric heat jobs, has bonded most of them, and has had to "make good" on only 5 or 6, an impressive indication of the thoroughness with which all details have been studied and worked out.

Essentially, the bonding process works like this. After a heating job has been completed, the customer is given a performance bond which guarantees that electrical energy for a full heating season will not cost more than the amount stated on the warranty. If the stated cost is exceeded during the season covered by the bond, Solar Electric Heat will pay the difference, and the bond remains in effect until the annual cost does fall below the guarantee. The provisions of the bond permit Solar to improve the home's insulation at no cost to the homeowner if the operating cost exceeds expectations.

Olson feels that if the annual energy used falls below the amount prescribed during one season, it will continue to do so, particularly since heat losses will normally decrease once the moisture inherent in new building materials has dried out. Annual costs are figured for the bond on the basis of a maximum energy usage for each 1000 cu ft of heated area of 0.163 kwhr per degree-day. For an 8-ft ceiling height, a normal 5866 DD year, and the present power rate of 1.55 cents per kwhr, this boils down to about 12 cents per sq ft of floor area. Multiplying 12 cents by the specific floor area gives the annual maximum cost guaranteed by the bond.

For an 8-ft ceiling height, this usage may be expressed also as 1.3 kwhr per 1000 sq ft per degree-day, which is in itself about one-third lower than today's general achievement in the industry. Actual meter readings show an average for all homes installed by Solar of under 1.0 kwhr (9.2 cents per sq ft) with some as low as 0.72 (5.9 cents per sq ft). These lower attainments take care of degree-day variations from the annual average.

FIG. 1. RECOMMENDED HEAT-LOSS FACTORS

Nature of loss	Solar		NEMA	
	Btu/hr	Watts	Btu/hr	Watts
Ceilings	.03	.0088	.048	.014
Floors	.03	.0088	.072	.021
Outside walls	.0625	.0183	.082	.024
Doors and windows	.59	.173	None	None
Infiltration	½ air change per hour		None	

It has been found that a home with its major window areas facing south will heat for 6 to 8 cents per sq ft per year; if they face east or west, it will run 8 to 10 cents; and if they face north, 10 to 12 cents.

Since north-facing homes run close to the bonding figure, such jobs are considered very carefully. The regular bond is not given if the north windows comprise more than 8% of the total outside wall area of the building. If the major windows face east or west, the percentage can be higher, and for southern exposure total glass can go up to 20%. Where window area is more than 20% of total wall area, electric heat is not encouraged.

Solar Electric Heat & Insulation was formed in 1956 after Olson had several homes with favorable heating records behind him. Sales went up; he took more people into his business. He established dealers in five towns in Idaho, two in Utah, one in Colorado, and one in California. There are about 42 full-time employees in the company today.

Submetering, installed on hundreds of heated homes, verify calculations on heat loss and heat gain factors from every angle. Most of Olson's research has come from his own home. He not only keeps daily records of heating energy and energy for other purposes, but gathers data on temperature, wind speed, and sun effect.

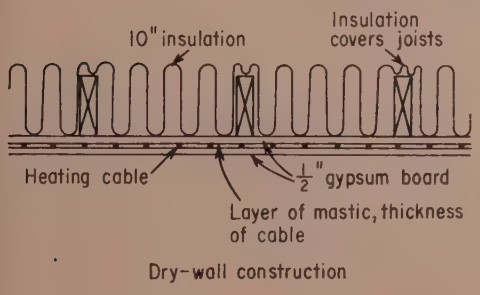
Most of the concern's work has been in a new residential construction, although they have done a restaurant, a motel, a theatre, a court house, and two schools, and tentatively expect to do a new hospital.

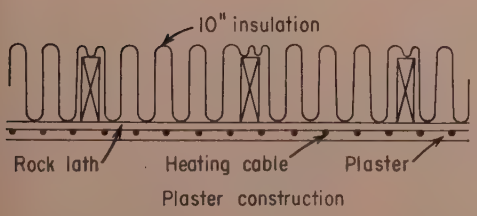
In an attempt to make economical electric heat available to more people than their operations can hope to take care of, Solar has established the Institute of Electric Heating and Insulating whereby, for a fee, Solar will agree to instruct members in their methods and installation techniques. They will also issue their regular guarantee of annual heating costs on members' jobs for a further fee based on a percentage of the job contract —provided that established insulating standards are followed. In such cases, the Institute officers are notified when the job is commenced and make a personal inspection of construction and insulating workmanship. The first Institute course began at the beginning of 1960, with four electrical contractors and two insulators as members.

The Institute will logically bring more competitors into Solar's areas of operation; but Olson feels that with the promising electric heat market opening up, there will be competition eventually anyway; and it's better to have them qualified to do the job as it should be done. Also, through use of the indemnity bond, there will be an opportunity for consistent policing to see that the jobs are done correctly. He sees gas as the real competitor, not other electric heat installers.

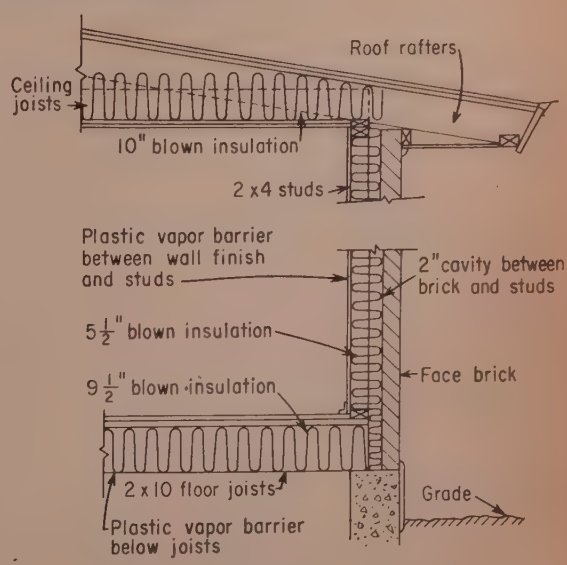
What about gas competiton in the area? Natural gas used for heating costs .04347 per 100 cu ft with a rated value of 875 Btu per cu ft; the gas people claim an average heating cost of 9.5 cents per sq ft per year. Olson is able to justify his guarantee of 12 cents per sq ft by showing that the following additional annual costs apply to the gas installation:

FIG. 2. TYPICAL CONSTRUCTION DETAILS





CEILING CABLE INSTALLATION



TYPICAL BUILDING SECTION

FIG. 3. OPERATING DATA [1]

1958–1959 Heating Season

House		A	B	C	D	E	F	G	H
Insulation [2]		10–5½–9½	10–5½–9½	10–5½–9½	10–5½–9½	10–3½–9½	10–3½–9½	10–3½–9½	10–3½–4
Heated area (sq ft)		1157	1682	2024	1098	1688	1362	750	983
Degree-days		5297	5297	7000	5297	5297	5297	5297	5297
Design Temp Diff (deg F)		80	80	80	80	80	80	80	80
Ratio, glass and door area to gross wall area (%)		17.1	20.7	16.3	14.2	15.6	18.6	15.3	17.3
Principal glass exposure (north, south, east or west)		E	S & W	N & S	SE	S	S	E	W
Space beneath floor (CS: crawl space; B: unheated basement)		CS	B	CS	B	CS	CS	B	B
Installed capacity [3]	Watts	8650	13,400 [4]	17,500 [5]	8,750 [4]	12,500	11,100 [5]	5,600	8,250 [4]
	Watts/sq ft	7.5	8.0	8.6	8.0	6.6	8.1	7.5	8.4
Design heat loss (1⅛ air changes per hour)	Btu/hr	32,390	48,555	54,710	33,270	47,460	40,645	23,111	33,855
	Kw	9.5	14.2	16.0	9.76	13.9	11.9	6.78	9.94
	Btu/hr/sq ft	28.0	28.9	27.0	30.3	28.1	29.8	30.8	34.4
	Watts/sq ft	8.2	8.46	7.9	8.87	8.22	8.72	9.02	10.1
Design heat loss (½ air change per hour)	Btu/hr	24,060	36,380	40,060	25,230	35,180	30,735	17,681	26,775
	Kw	7.05	10.65	11.9	7.4	10.3	9.0	5.18	7.84
	Btu/hr/sq ft	20.8	21.6	19.8	23.0	20.8	22.6	23.6	27.2
	Watts/sq ft	6.1	6.33	5.8	6.75	6.1	6.61	6.9	7.96
Estimated annual energy (NEMA formula; 18.5 constant; 1⅛ air changes per hour)	Kwhrs	11,608	17,388	25,880	11,908	16,960	14,547	8,243	12,116
	Kwhrs/sq ft/1000 DD	1.89	1.95	1.83	2.05	1.90	2.02	2.07	2.33
	Ratio to actual annual energy	2.6	2.1	2.4	2.1	2.1	2.5	1.9	2.0
Estimated annual energy (NEMA formula; 18.5 constant; ½ air change per hour)	Kwhrs	8,625	13,030	18,950	9,030	12,570	11,000	6,310	9,580
	Kwhrs/sq ft/1000 DD	1.41	1.46	1.34	1.55	1.41	1.52	1.59	1.84
	Ratio to actual annual energy	2.0	1.6	1.7	1.6	1.5	1.9	1.4	1.6
Actual metered heating energy	Kwhrs	4,397	8,381	10,986	5,557	8,150	5,887	4,422	5,923
	Kwhrs/sq ft/1000 DD	0.72	0.94	0.77	0.96	0.91	0.82	1.11	1.14
Calculated NEMA constant to produce actual metered energy	1⅛ air change per hr	7.0	8.9	7.8	8.6	8.9	7.5	9.9	9.0
	½ air change per hr	9.4	11.9	10.5	11.3	12.0	9.9	12.9	11.4

[1] Operating costs verified by Utah Power & Light Co. Houses chosen for analysis represent the entire spread from highest to lowest operating costs which could be found among hundreds heated and sub-metered.
[2] Figures given represent inches of vegetable fiber insulation (0.28 Btu/hr/sq ft/deg TD) in ceiling, wall, and floor, respectively.
[3] Ceiling cable, except as noted. [4] Includes 750-watt bath ceiling heater. [5] Includes two 750-watt bath ceiling heaters.

Maintenance of furnace	$18
Housecleaning and redecorating	20
Floor space lost to furnaces	10
Depreciation of equipment	20
Total	$68

For a home of 1100 sq ft, this amounts to 6 cents per sq ft. Added to the cost of fuel, the annual cost becomes 15.5 cents per sq ft. Even if these extra costs are cut in half, the net annual cost is 12.5 cents per sq ft, higher than the 12-cent guarantee—and electric heat's advantages are working for him.

Design and Installation

Olson attributes the remarkable results of his work to (1) detailed, accurate evaluation of the real contribution of heat sources other than the heating system to the total requirements, and (2) use of thermal insulation greatly exceeding thicknesses in common use today—plus constant attention to top-notch workmanship.

His general procedure is to calculate the total annual heat loss and then subtract estimated heat gains from other sources. He has recognized the inadequacy of the NEMA

FIG. 4. ANNUAL HEATING COSTS (DOLLARS)*

Projection of average results of test houses described to smaller and larger heating areas at various energy rates.

Annual Degree-days	1000 sq ft			1200 sq ft			1400 sq ft			1600 sq ft			1800 sq ft			2000 sq ft		
	Cents per kwhr			Cents per kwhr			Cents per kwhr			Cents per kwhr			Cents per kwhr			Cents per kwhr		
	1.0	1.5	2.0	1.0	1.5	2.0	1.0	1.5	2.0	1.0	1.5	2.0	1.0	1.5	2.0	1.0	1.5	2.0
4000	36	54	72	43	65	86	50	76	101	58	86	114	65	97	130	72	108	144
5000	45	68	90	54	81	108	63	95	126	72	108	146	81	122	162	90	135	180
6000	54	81	108	65	97	130	76	112	151	86	130	173	97	146	194	108	162	216
7000	63	95	126	76	112	151	88	132	176	101	151	202	113	170	227	126	189	252
8000	80	108	144	86	130	173	101	151	202	115	173	230	130	194	259	144	214	288

* Based on 0.9 kwhr per sq ft per 1000 degree-days

and FHA formulas in accounting for these variables where the houses are heavily insulated.*

In general, insulation, weatherstripping and storm sash must be installed to meet the maximum permissible design heat losses shown in Fig. 1. The corresponding NEMA standards are included for comparison. This boils down to 10 in. of insulation in the ceiling, 3½ in. in the walls, and 9½ in. in the floor, with storm windows and doors a "must." Most of his houses use 5½ in. in the walls, made possible by the omission of sheathing on the outside of the house. The standard 2 by 4 stud space plus a 2-in. cavity between framing and brick exterior makes this space available. Extra corner bracing is used to make up for some structural strength lost by absence of the sheathing. Solar uses a vegetable fiber blown insulation with a .28 U-factor, giving R-values of 36, 19 and 34 in ceiling, walls, and floors, respectively.

After framing and outside wall finish has been completed, window and door frames are packed tightly with mineral wool loose insulation. Then 4-mil transparent plastic sheets are stretched over the inside surface of the studs and stapled to the studs. A heavy cord grid is used over the plastic as shown in the accompanying photograph; staples fastening the plastic straddle the cord and strengthen the plastic to prevent tearing around the staples under pressure of the insulation.

Round holes are then cut in the plastic in each stud space through which the nozzle is inserted for blowing in the insulation. Insulation is packed as tightly as possible to prevent settling and still permit the plaster or gypsum board to be installed without undue hardship. Since the plastic is clear, the effectiveness of the entire insulating job may be judged and corrected. The hole in the plastic is then sealed.

Where there is a ventilated attic space above, no vapor barrier is used in the ceiling. Where the roof is directly on the ceiling joists, the plastic film is used beneath the joists. In such cases, the entire joist space is blown full of insulation. With an attic above, insulation is blown to the 10-in. depth over the tops of the joists.

Floor joists, usually 2 by 10's, are filled completely with insulation; the plastic vapor barrier is fastened to the underside of the joists. Olson believes the heavy insulation in the floor to be one of the most important factors where ceiling heat is used, feeling that it would pay to follow this procedure even if electricity were free because of the comfort provided.

Where basements are to be heated, the walls are furred out with 2 by 2's backed by a 2-in.-wide strip of Celotex ½ in. thick. This gives at least 2½ in. for insulation and helps to absorb any unevenness in the concrete. A 2-in. blanket is then installed between the 2 by 2's, or the space is blown full as in upstairs walls. If the floors are less than 3 ft below grade, they are provided with perimeter insulation. Fig. 2 shows typical building sections with insulation installed.

Occupants have had no complaints with electric heat; they consistently report maximum comfort and freedom from respiratory ailments. Perhaps the most frequently voiced criticism of Solar's system by competitive heating people is that such tightly insulated homes must have an adverse effect on the quantity of oxygen available to the occupants. However, Olson points out that a person normally requires 300 cu ft of fresh air per minute. A 1500-sq-ft home with 12,000 cu ft of space, even at ½ air change per hr, receives 6000 cu ft of fresh air per hr—enough for 20 people. Also, there is no combustion process constantly using up the oxygen supply.

Test Results

The metered data from eight homes chosen for analysis, as shown in Fig. 3, attest to the thoroughness and efficiency of the methods used. Design heat-loss figures shown in the table were calculated twice — first assuming 1⅛ air changes per hr per local utility practice, then assuming only ½ air change per hr, which more closely reflects the effect of the heavy insulation and high degree of workmanship used in the installations. As shown, the difference in each case is approximately 8 Btu/hr/sq ft, a significant amount. Applying the NEMA formula with an 18.5 constant to both computations gives what would be the estimated annual energy per prevailing practice.

The difference between estimated and actual energy, at ½ air change per hr, shows an over-estimate of 140 to 200%, and up to 260% using 1⅛ air change per hr.

Substituting the results in the

* For discussions of this problem see *Electrical Construction and Maintenance* articles "Problems in Estimating Electric Heating Costs" (August, 1959), and "A Manual of Electric Space Heating—1960" (March, 1960).

OUTSIDE WALLS are filled with insulation through 2½-in. holes in transparent plastic vapor barrier. An additional 12- to 15-in. strip of plastic is then stapled to the studs across the hole to seal the opening. Cord adds strength to plastic and prevents tearing at staples. Note absence of sheathing from wall at right. Insulation will fill 2-in. space between studs and brick, eliminating the direct conduction path from wood to brick. Continuous humid days in this area are few; therefore no adverse moisture effects have been experienced due to the omission of the sheathing.

FLOOR INSULATION is contained by sheet of 5-mil plastic stretched beneath joists. Staples are inserted over heavy cord to avoid tearing of plastic by pressure of insulation.

PNEUMATIC BLOWING equipment for installing insulation is built onto truck body. Operation is entirely automatic, requiring only one man in the building at the end of the hose. A second truck is now being constructed. Truck is shown above at site of 14-unit apartment building being insulated for electric heat.

NEMA formula and solving for C gives the very low values shown in Fig. 3, ranging from 7 to 9.9 for 1½ air change and from 9.4 to 12.9 for ½ air change. This is quite a step from 18.5. What makes the difference? In all probability, the two extremes of infiltration rates used bracket the actual conditions encountered. The most likely explanation is that heat gains from other sources in heavily insulated homes provide such a great part of the total heat requirements that any attempt to account for their effect by using a formula which assumes them to be proportional to the design heat loss must be invalid. Also, perhaps established heat-loss calculations, never brought to task before in sizing fuel-fired equipment, include too much of a safety factor.

Because of the careful construction practices adhered to in these homes, it must be assumed that ½ air change per hr is more accurate than 1½. Therefore, if the NEMA formula is used for such homes, a constant of 11 should be adopted in this area.

Note that the largest of the eight homes (C) is in a 7000-degree-day area, yet shows the second lowest actual energy used. This is a strong argument that electric heat is practical anywhere in the United States, and not only in small homes.

The energy usage in these houses having 10-5½-9½ insulation averages about 0.9 kwhr per sq ft per 1000 degree-days. General attainment in the industry today is somewhere around 2 kwhr. Fig. 4 shows annual heating costs for homes of various sizes at 1.0, 1.5, and 2.0 cents per kwhr based on 0.9 kwhr per sq ft. These are low costs. Of course, they assume that heat gains from other sources will be constant in all areas. While this may be approximately true with respect to heat from lighting and appliances and body heat, there will be a significant variation in sun and wind effects. Only experience and diligent observations such as Floyd Olson has made can accurately indicate what these variations will be.

Obviously, a home insulated to this extent will cost more initially. What determines the economical limit of insulation thickness? Olson agrees with other far-thinking individuals interested in electric heat who maintain that construction and insulation should be adopted which produce the lowest combined cost of mortgage and electricity.

The exact extra cost will depend upon the extent to which the house would otherwise be insulated. A carefully constructed 6-4-2 insulated home may be expected to run about 1.8 kwhr/sq ft per 1000 degree-days; hence the annual electric heating cost for a 1200-sq-ft house at 6000 degree-days and 1.5 cents per kwhr would be $195. From Fig. 4, a 10-5½-9½ insulated home at 0.9 kwhr per 1000 degree-days would just about cut this cost in half, to $97—a saving of $98. The home with the heavier insulation would cost more for insulation and less for installed equipment and would run from $250 to $300 more than the 6-4-2 home. Assuming the higher figure, this would mean about $21 more per year on a 30-year FHA mortgage. Thus the homeowner realizes a net annual saving of $98 minus $21 or $77.

Full insulation is usually installed in the floor above heated basements for sound deadening purposes and to give better temperature control. Because ground exposure temperatures are less than outdoor temperatures and infiltration is a minimum, annual basement heating costs are estimated at two-thirds the upstairs cost per sq ft.

Conclusions

Solar's whole philosophy may be summarized as follows: The heating cost represents the difference between the heat that is lost from the home and the heat that is gained from the sun and other sources. Since neither is known exactly, the aim should be to keep this difference as small as possible. Since the heat gain is not materially affected by the insulation, any lowering of heat loss will result in a much greater reduction in heat that must be supplied. Olson feels that he has reached a point where, if he could reduce the heat loss by another 10%, the heating costs, as low as they are, would be reduced another 20 to 25%.

It is obvious that new thinking along the lines described here must accompany the extension of electric heat to its destined mass market. The installer must avoid treating heating equipment in terms of an appliance to be dropped in place by rule-of-thumb methods, disassociated from important influencing factors, from the functions it is designed to serve, and from the effect its application will have on both the structure and its occupants.

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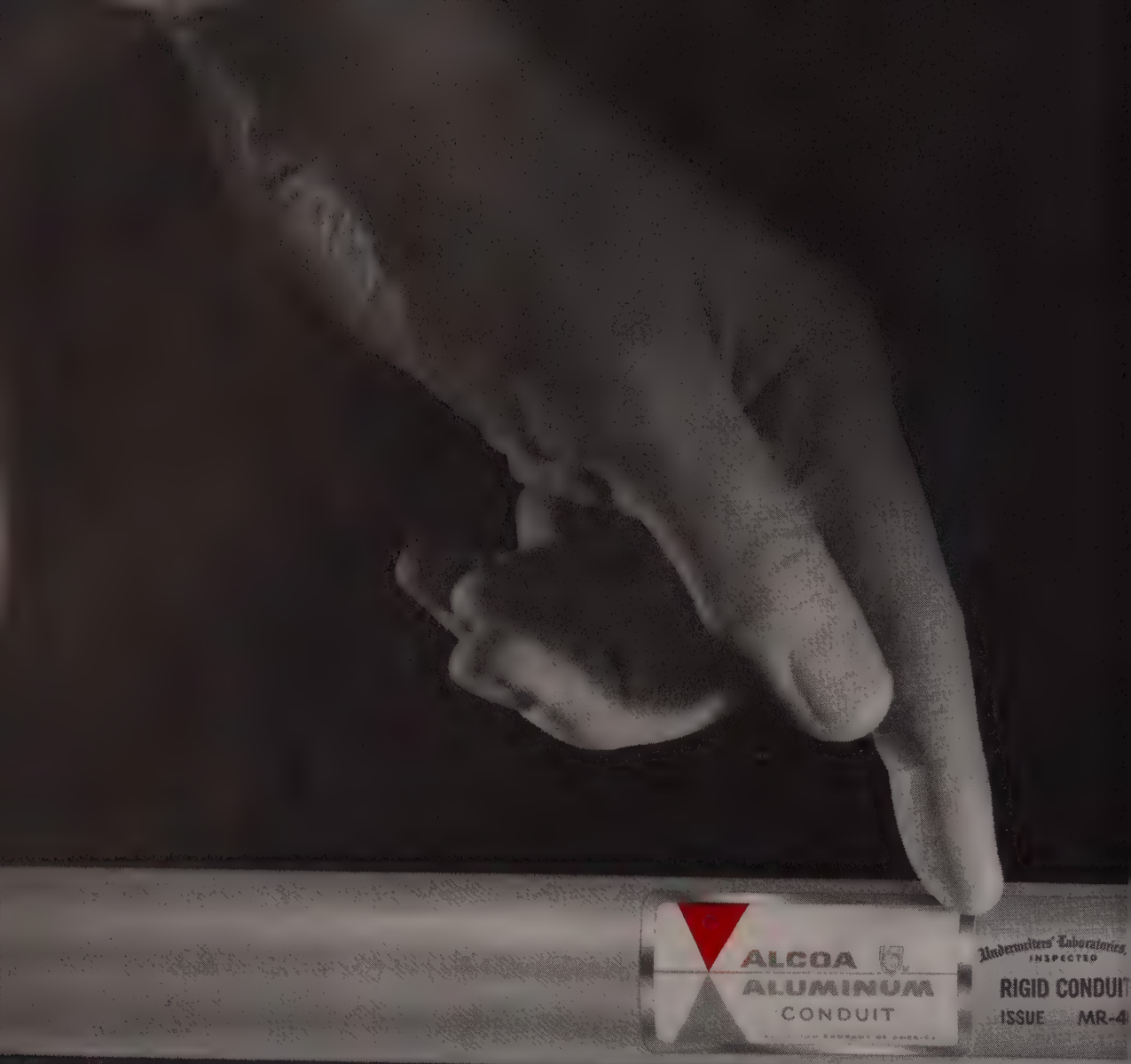

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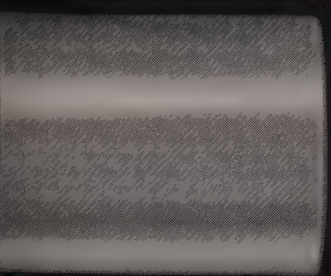

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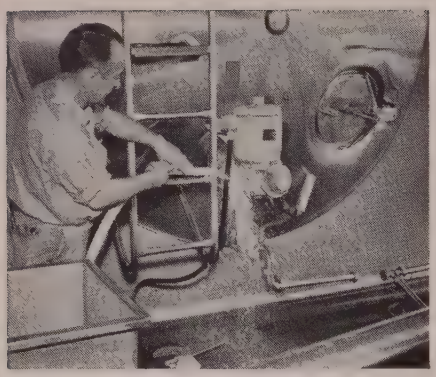

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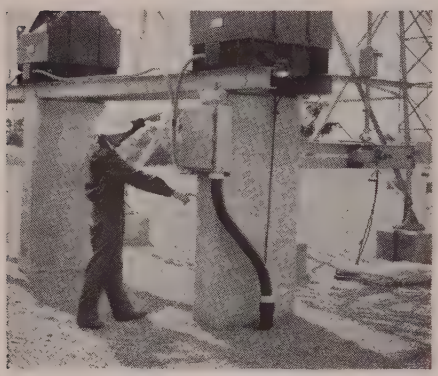

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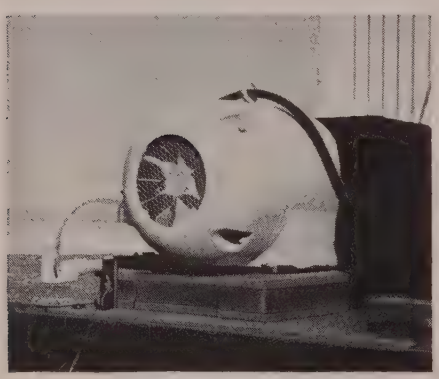

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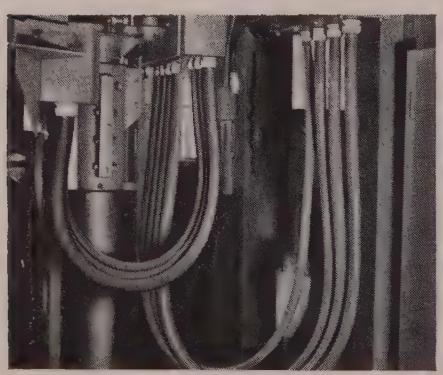

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TRADE SIZE (Ins.)	INSIDE DIAMETER Min.	INSIDE DIAMETER Max.	OUTSIDE DIAMETER Min.	OUTSIDE DIAMETER Max.	Appr. Inside Bend Diam. (Ins.)	Approx. Shipping Wgt. (Lbs.) Per Std. Carton
3/8	.484	.504	.690	.710	6	60
1/2	.622	.642	.820	.840	7	70
3/4	.820	.840	1.030	1.050	10	70
1	1.041	1.066	1.290	1.315	12	90
1 1/4	1.380	1.410	1.630	1.660	15	70

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TRADE SIZE (Ins.)	INSIDE DIAMETER Min.	INSIDE DIAMETER Max.	OUTSIDE DIAMETER Min.	OUTSIDE DIAMETER Max.	Appr. Inside Bend Diam. (Ins.)	Approx. Shipping Wgt. (Lbs.) Per Std. Carton
3/8	.485	.505	.690	.710	4	60
1/2	.620	.640	.820	.840	5	60
3/4	.815	.835	1.030	1.050	5	70
1	1.030	1.055	1.290	1.315	7	60
1 1/4	1.370	1.395	1.635	1.660	8	80
1 1/2	1.575	1.600	1.875	1.900	11	55
2	2.020	2.045	2.350	2.375	14	75
2 1/2	2.480	2.505	2.850	2.875	19	105
3	3.070	3.100	3.470	3.500	23	80
4	4.000	4.040	4.460	4.500	27	105

Commercial tolerances apply on above figures.

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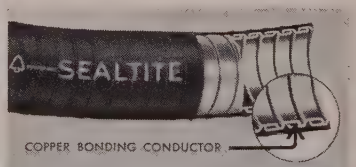

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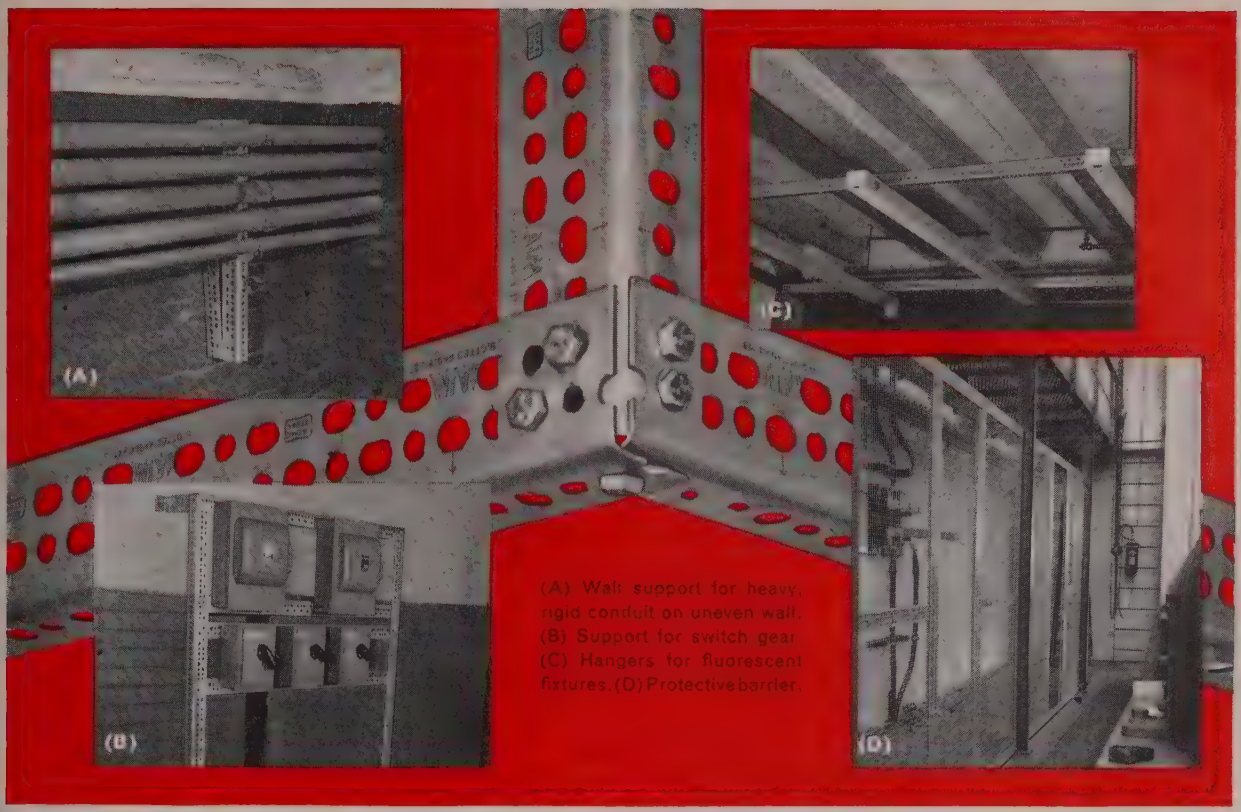

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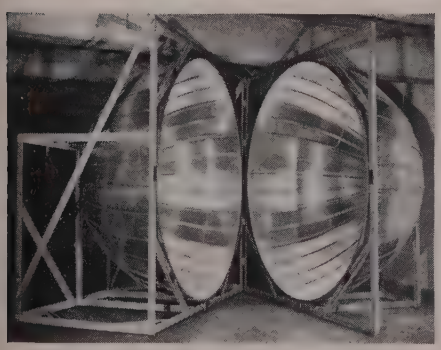

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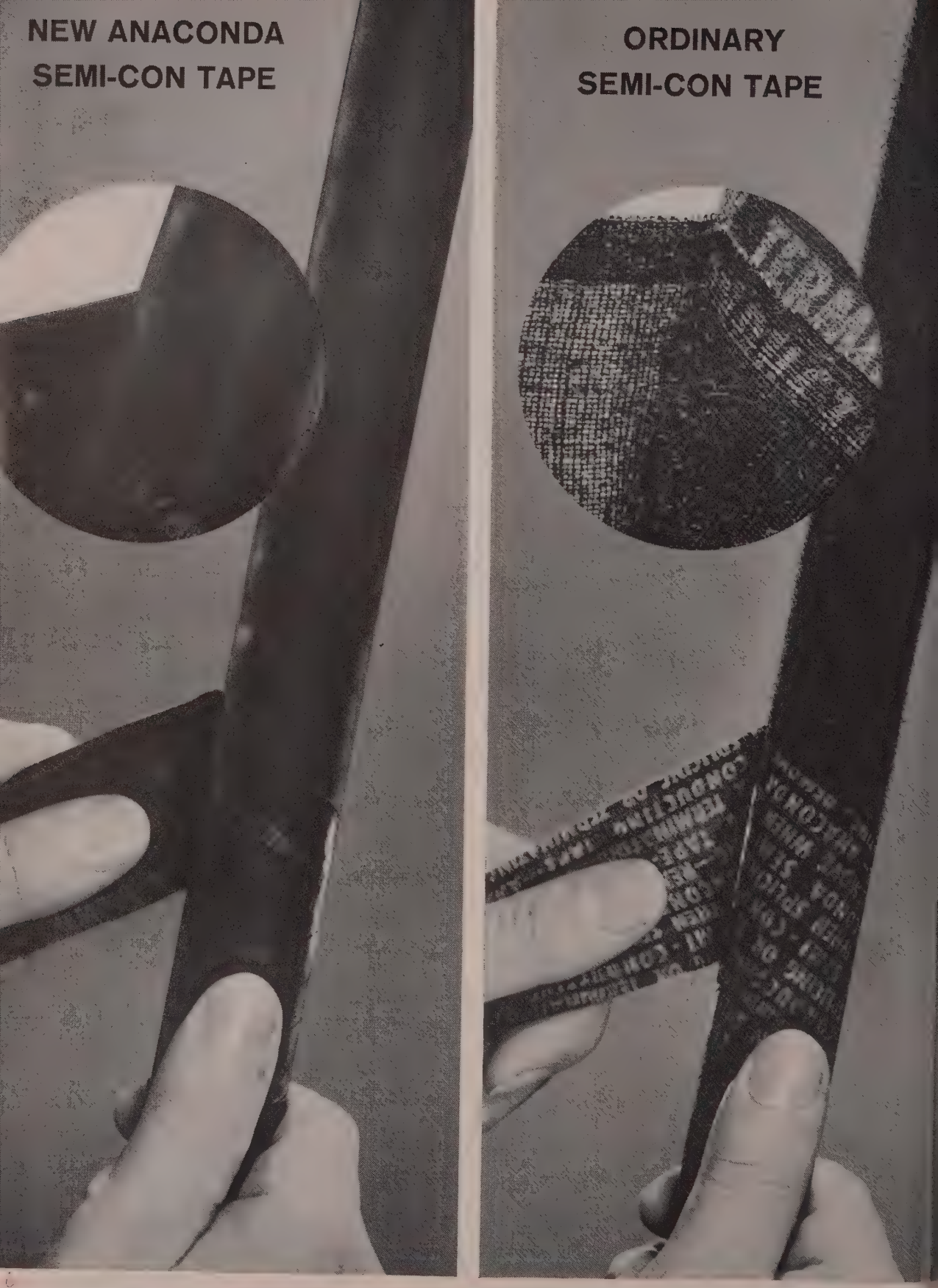

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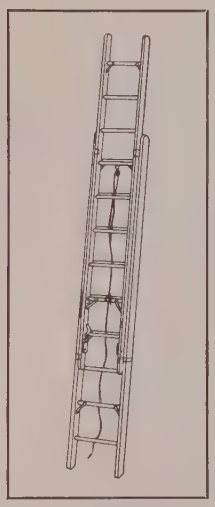

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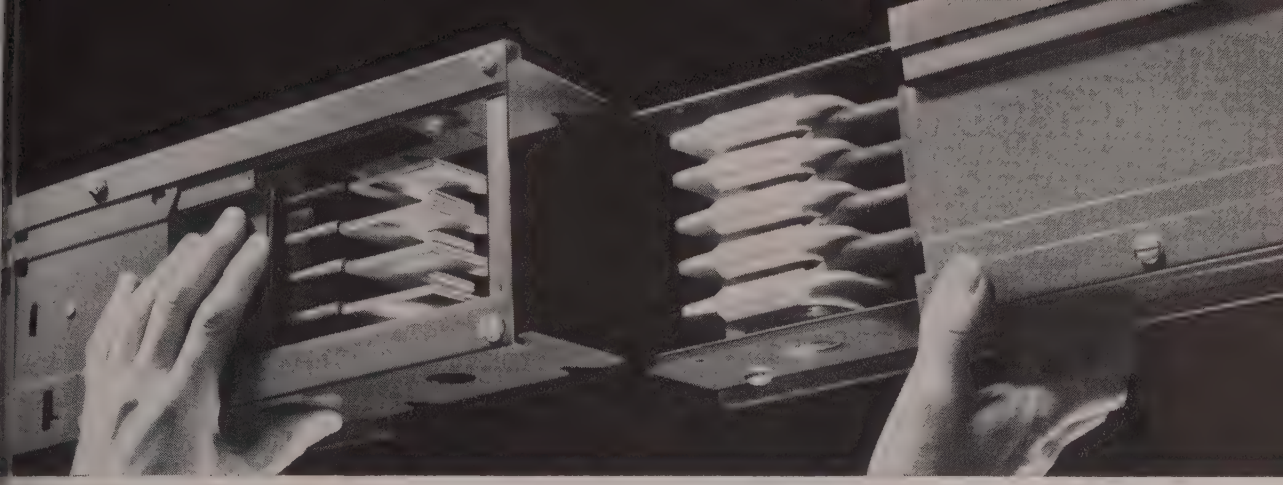

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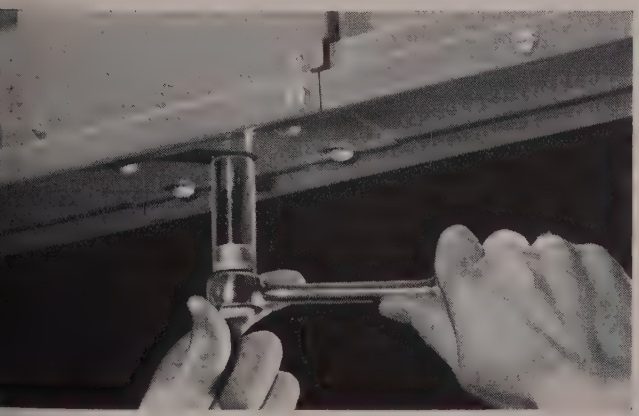
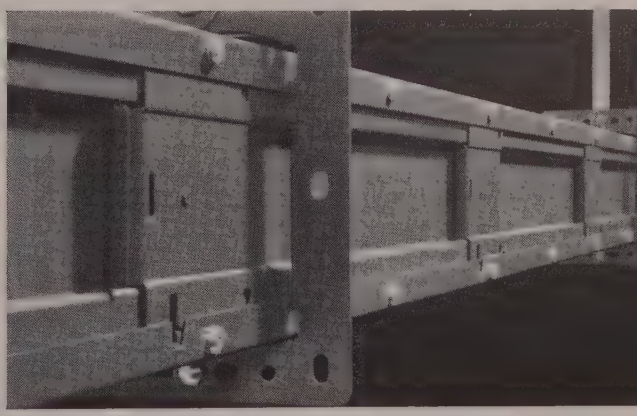


SINGLE INTEGRAL BOLT puts a ton of pressure on keyed bus ends. Joints lock tight *fast*, stay locked.



TEN-FOOT SPANS take fewer hangers and less time to install than ordinary duct.

BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY

KEEP PACE WITH ELECTRICALLY

TOP QUALITY PRODUCTS . . . Distributed by Graybar

Fashion Plate

from BRYANT

Exciting new idea in wall switches

Lets the builder or owner match, blend or contrast any decorating scheme

TOP QUALITY PRODUCTS . . .

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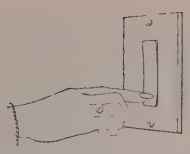


TAP-EEZ . . . new tap-action, flush-mounted switch for buildings, institutions and stores. Rugged enough for all a-c applications, yet much more attractive than ordinary switches.

FASHION PLATE SUCCESS STORIES CONTINUE TO POUR IN!

Fashion Plate opens up more business in new construction . . . homes, buildings, institutions

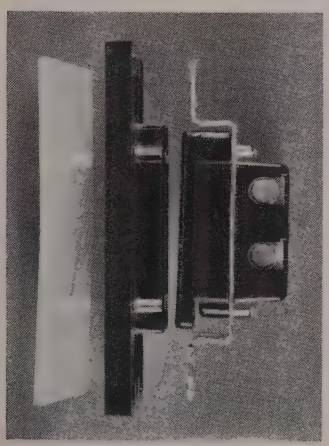
". . . Fashion Plate is being installed in 200 new homes, all because switches were placed in several model homes."

". . . so successful in getting Fashion Plate into a big Motel, that we have gotten the specs changed to Fashion Plate on a major hotel job and a new school."

". . . new rehabilitation center specified Fashion Plate due to the ease of operation for patients in wheelchairs or not having complete use of their limbs."

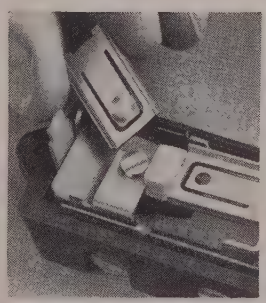
YOU CAN GET IN ON THIS SUCCESS!
Fashion Plate has visual appeal and ease of operation that practically sells itself. As for the quality, take it apart and see for yourself. Then call your Bryant representative. Get his assistance. And put your people to pushing Fashion Plate. (P.S. Don't forget there's a bigger dollar profit in Fashion Plate, too!)

FASHION PLATE is a trade-mark of The Bryant Electric Company

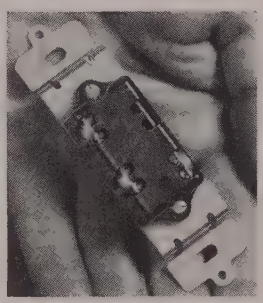


UNLIMITED APPLICATIONS—AVAILABLE IN SINGLE, TWO, THREE AND FOUR GANG COMBINATIONS—WITH CLEAR, WHITE OR IVORY ACTUATORS, BLACK OR WHITE BACK PLATES

Smooth, quiet action. Low installation cost. Listed by Underwriter's Laboratories, Inc.



Silver alloy contacts insure long life. Positive controlled contact action.



Compact design. Fits standard switch boxes. Requires no special wiring.

Time-saving, clamp-type back wiring terminals make installation quick and easy.

Fashion Plate

The exciting things come from

BRYANT

THE BRYANT ELECTRIC COMPANY, BRIDGEPORT 2, CONNECTICUT

J-99024

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

NOW! Fuses that...

Safely interrupt fault currents up to 200,000 amperes...

Limit fault current to very low values

Hold 500% load for minimum of ten seconds

Buss Low Peak fuses can completely revolutionize the protection of the entire electrical system.

Protect Mains, Feeders, Branch Circuits, Motors, Controllers, Switches—no matter whether the fault current is 1,000 amperes, 25,000, 100,000—or as high as 200,000 amperes.

Reduce stresses and prevent damage to Panel-boards, Switches, Motor Controllers—other circuit components—because let-thru fault currents are limited to exceptionally low values.

Prevent work stoppages, lights out, waste of time and money—because long time-lag keeps them from opening needlessly on motor starting currents or other harmless overloads.

Permit increasing interrupting capacity and current limitation on present system at minimum cost.

Before designing a new installation— or modernizing old installations—

GET ALL THE FACTS

Knowledge without action is of little value—but ACTION NOW may save you money—increase operating efficiency and reduce electrical hazards to a minimum.

BUSS LOW-PEAK fuses fit standard Switches and Panel-boards and are available in N.E.C. sizes from 15 to 600 amperes in both 250 and 600 volt ranges.

Write for BUSS LOW-PEAK Bulletin Now . . . or use coupon.

Bussmann Mfg. Division
McGraw-Edison Co.
St. Louis 7, Mo.

TOP QUALITY PRODUCTS . . . Distributed by Graybar

Bussmann Mfg. Division, McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.
Please send BUSS Low-Peak Fuse Bulletin LPS.

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Title.....

Company.....

Address.....City.....State.....

ECM-460

TOP QUALITY PRODUCTS

Distributed by Graybar

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with the

HYLUG KIT #11

Bolt Cutter

Wire Cutter

Indentor

Crimpers

Thread Chasers

Insulation Grip Closers

Come and get 'em . . . a $3.95 tool FREE in every kit . . . a tool with all the features you've been looking for . . . crimper and wire cutter in the nose, wire stripper, the slickest bolt cutter you've ever seen . . . and handles that fit your hand like a glove. And what a buy in the kit itself . . . 250 one-piece HYLUGS packed in 3 Flip-Top boxes . . . 18, 14 and 10 sizes. Flip them out as easily as you flip a cigaret out of its pack. This is an offer you don't want to miss. Don't wait . . . call your local BURNDY distributor now . . . he has kits in stock and will be glad to show them to you. HYLUGS in Flip-Top boxes come in 29 popular sizes.

Items bought separately cost $11.45

price of Kit #11 complete with Y10M HYTOOL **$6.50**

BURNDY, Norwalk, Connect. or Toronto, Canada

BURNDY

58-8

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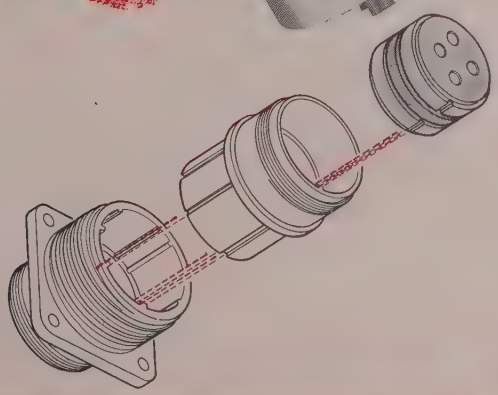
NEW ... by CROUSE/HINDS

ARK-trol®

ELECTRICAL CONNECTORS



• Foolproof polarization • Errorless assembly • Maximum interchangeability • Environmental: Exceed rigid military and industrial requirements for resistance to corrosion, chemicals, high and low temperatures, pressure, shock, vibration, dust, humidity, moisture, and leakage of air.

POSITIVE POLARIZATION

Completely foolproof: plug can be mated only with proper receptacle, and in only one way . . . the *right* way. Unsymmetrical contact arrangements preclude improper mating of contacts, or mating of unmatched contact configurations.

FAST, EASY, ERROR-FREE ASSEMBLY

Polarization keyways and unsymmetrical contact arrangement in insert assemblies make improper assembly of parts impossible. One-piece 'snap-in' connectors. Soldering is done outside . . . *before* insertion of contacts.

SEALED AGAINST ENVIRONMENTAL FACTORS

'Stack' assembly includes silicone rubber wafer for impenetrable seal against water, vapors, dust, gas. Basic shells, other metal parts are high-strength extrusions of aluminum alloy, anodized for corrosion, abrasion resistance: 1800 volts are required to penetrate this coating.

MAXIMUM INTERCHANGEABILITY

Components in each diameter are interchangeable and reversible, doubling scope of equipment. Male *and* female shells take either pin or socket inserts: both plug and receptacle may be used 'hot' or 'dead'. Pin and socket configurations available in wide range . . . specials supplied on request.

SHELL SIZES and ELECTRICAL RATINGS

Four shell sizes: from 1-1/16" to 2-9/16" diam. *Voltages:* Military Service Ratings; A, D, E, B, C and Instrument. NEC Rating: 600V. A.C. *Contact sizes:* #16 to #4/0 inclusive. Write for Bulletin 2711 containing complete descriptions, specifications and configuration patterns for both Type RPE and RPC *ARK-trol* Electrical Connectors.

Available in two types:

TYPE RPE ENVIRONMENTAL
- Moisture Proof
- Shock Insulated
- Dust-Tight
- Corrosion Resistant
- Grounded & Non-Grounded

TYPE RPC CIRCUIT BREAKING
- All Features of RPE *Plus* . . .
- Circuit Breaking under full Rated Load

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TOP QUALITY PRODUCTS . . . Distributed by GrayBar

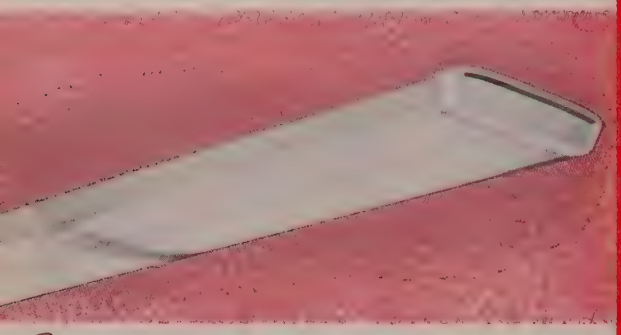
Look at These Market Preferred Lighting Fixtures from the wide Curtis-AllBrite line:

CURTIS **DESIGNER GROUP**

. . . a Forward Concept in Styling

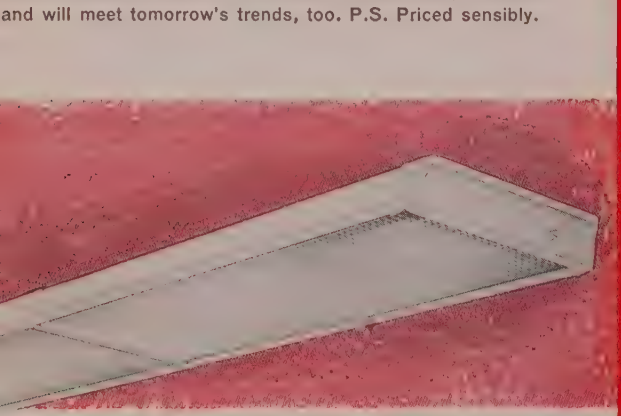
CURTIS

VISITRON . . . the trim luminaire with the future "designed in" for long range satisfaction. Here is a pleasing blending of contemporary and traditional design. P.S. Priced sensibly.



CURTIS

REGULA . . . flowing contours and advanced styling mean this luminaire will go well with today's contemporary interiors and will meet tomorrow's trends, too. P.S. Priced sensibly.



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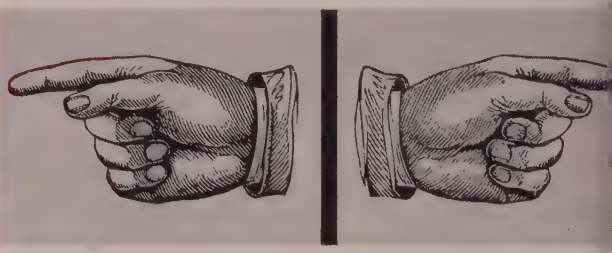
TYTRON . . . here's a fresh concept in styling—truly new, yet functional, too. Handsome and then some. Plastic louver or acrylic lens panels optional. P.S. Priced sensibly.

The lines combined



with you in mind

Now a new, expanded company formed by the union of Curt Lighting, Inc. and AllBrite Fluorescent Fixtures, Inc. brin you an all-embracing line—with wide selection in quality—wi range in price—wide scope of application

A thorough understanding of the total market is behin the development of the Curtis-AllBrite Lighting line. He the desires of end users as to quality, product applicatio and price . . . all are satisfied. And since those desires mak up your sales problems, it follows then that the Curti AllBrite line is a logical answer to improving sales. That why we say Curtis-AllBrite is the line combined with yo in mind . . . the line combined to sell because it meets th market needs. Curtis-AllBrite Lighting, Inc., AllBrite Ligh ing Division, 252 Shaw Road, South San Francisco; Curt Lighting Division, 6135 West 65th Street, Chicago 38, I

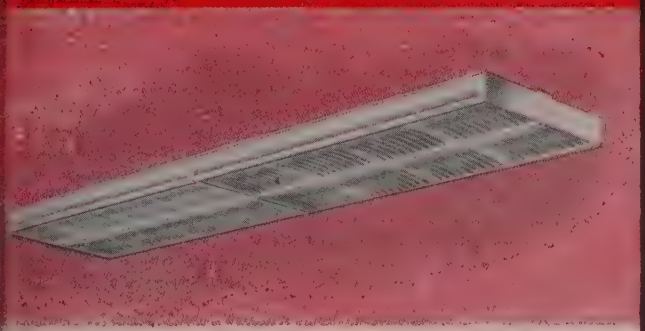
CURTIS

visioneers in planned lighting

All-Brite

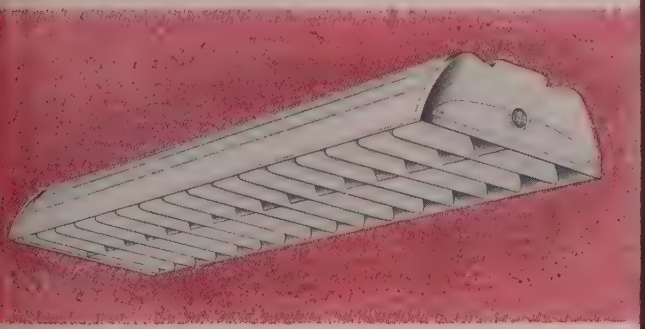
TOP QUALITY PRODUCTS . . . Distributed by Graybar

6 Luminaires with an accent on quality



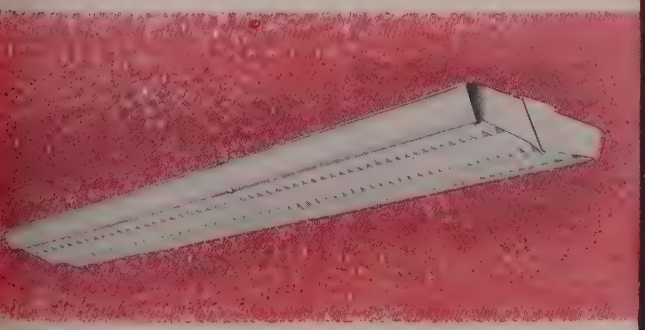
CURTIS

EDGE-GLO . . . high fashion styling is combined with high quality illumination in this luminaire that says distinction at a glance. Side panels, illuminated by reflected light, assure a soft, pleasant luminescence.



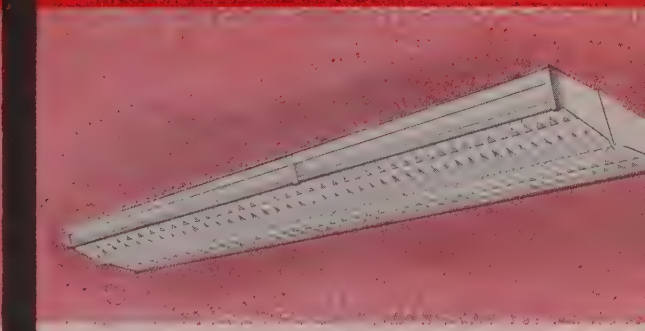
CURTIS

FORTY-SIXTY . . . excellent general illumination is provided by this truly quality luminaire. Available in shallow and deep units with a wide range of lengthwise and shielding angles and lamp types.



All-Brite

ASTRALOUVE . . . an exceptionally shallow and beautiful luminaire of high efficiency. Side panels are made of smooth translucent plastic, precision made. Surface or pendant mounting. Ideal for commercial lighting.

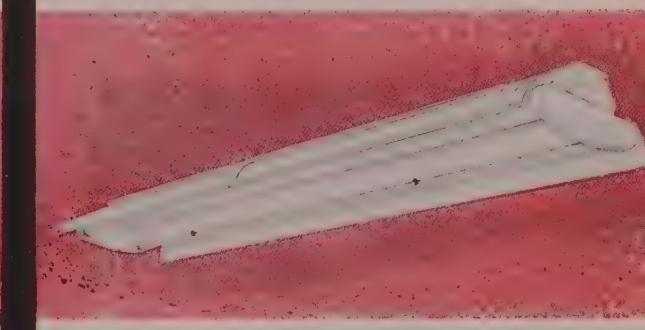


All-Brite

NEW DEAN . . . a slender, direct-indirect luminaire featuring illuminated all metal side panels, low brightness—high efficiency. Ideal for installations requiring thin fixtures. Designed for surface or suspension mounting.

All-Brite

RLM DELUXE INDUSTRIALIST with Upward Component . . . a luminaire combining sturdy construction, visual comfort, attractive appearance and true economy. Photometrically engineered extruded apertures correct proportion of light to ceiling.



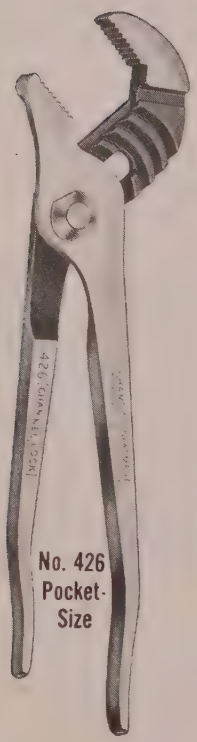
All-Brite

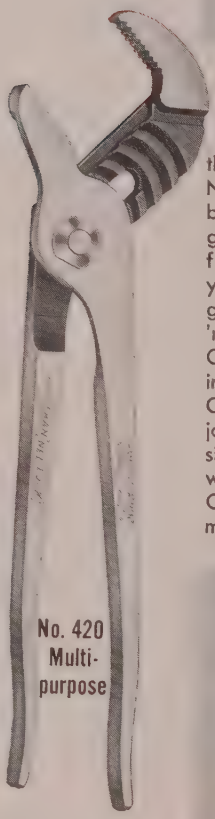
INDUSTRIALIST—high bay fluorescent . . . this truly functional luminaire is especially designed for power groove, SHO and VHO lamps. High output—heavy duty performance. Ideal for industrial use.

TOP QUALITY PRODUCTS . . .

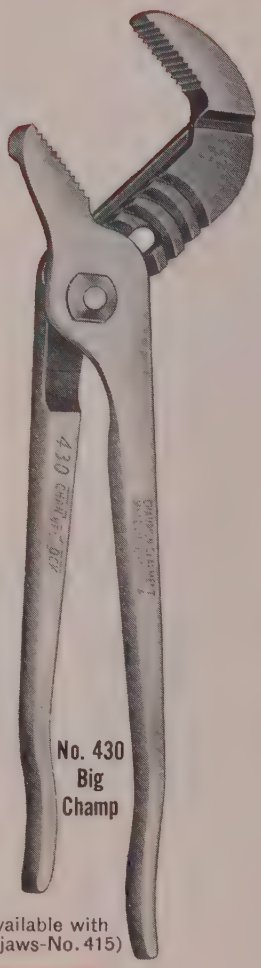
Distributed by GrayBar

You'll do Hundreds of Jobs Easier, Faster with ALL 4





You who use CHANNELLOCK know that no other plier does so many jobs so well. What you may *not* know is that you can choose the right CHANNELLOCK for every job . . . small or big. The four distinct sizes shown here give you a range of jaw capacities from ½" to 2". And all of them give you the same terrific, parallel-jaw gripping power . . . the same all 'round handiness that have made the CHANNELLOCK No. 420 a basic tool in every electrician's kit. So let CHANNELLOCK help you do *every* job easier, faster. Order all four sizes from your tool supplier. And when you do, be sure they're *genuine* CHANNELLOCKS. Look for the trademark on the handle.

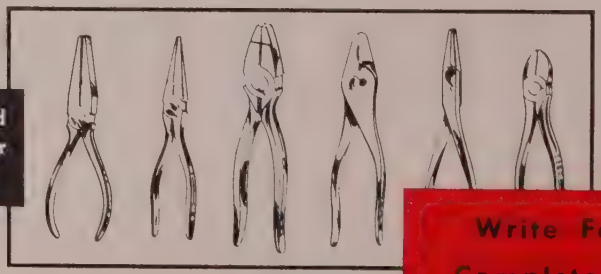


(also available with smooth jaws-No. 415)

CHANNELLOCK®

CHAMPION DEARMENT TOOL COMPANY • MEADVILLE, PENNSYLVANIA

. . . And There's A Standard Style CHANNELOCK Plier For Every Need



Write For Catalog of Complete Line of Pliers

TOP QUALITY PRODUCTS . . .

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WHICH TYPE

Cordley

WATER COOLER

DOES YOUR PLANT TRAFFIC REQUIRE?

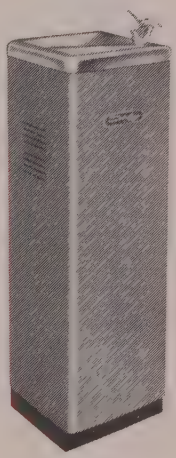
No matter what your space, budget, location, or capacity problems, you'll find the perfect solution in the *complete line* of Cordley Water Coolers. All quality-built Cordley Water Coolers bear the famous Cordley Five-Year Guaranty!

STANDARD?

Choose from 7 standard Cordley models . . . air cooled, water cooled, explosion proof. Mechanically operated hand and foot controls are failure-proof. Also available in low height model.

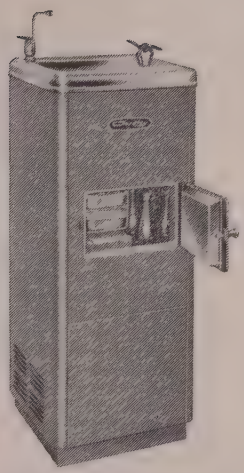
WALL HUNG?

Cordley Cordwalls are off the floor, on the wall, and conceal all plumbing. Can be installed at any height and recessed to any depth. Save up to ⅔ wall space. Two models to choose from.



COMPACT?

Use only one square foot of floor space with the Cordley Compact Water Cooler. Also available in bottle type unit.

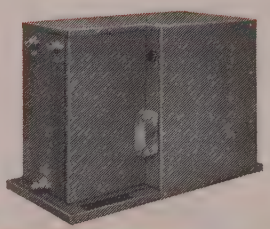


HOT AND COLD WITH REFRIGERATOR COMPARTMENT?

Here's Cordley's answer to the "coffee break" problem . . . and the cold storage problem as well. The Cordley Hot and Cold Water Dispenser with refrigerator compartment serves enough refreshingly cooled water for about 35 plant workers...and enough piping hot water to make 60 cups of coffee per hour. Storage compartment keeps drinks, lunches, drugs, and biologicals at refrigerator temperature. Freezes two trays of ice cubes. Also available in bottle type.

REMOTE?

Pick from 6 models...4 air cooled and 2 water cooled. One Cordley Remote Cooler may serve several fountains...sizes up to 23 gallons per hour. 2 special "Wall-Hide" models...only 6¾" deep...fit between walls.



THE FAMOUS CORDLEY FIVE-YEAR GUARANTY

A new cooler will be supplied if a defect occurs in the hermetic factory-sealed refrigeration system or cooling tank and freight will be paid both ways within continental U.S. (Copy supplied upon request.)

Ask your Graybar representative to give you full details on the Cordley line of top-quality, guaranteed Water Coolers. Or write for Catalog.

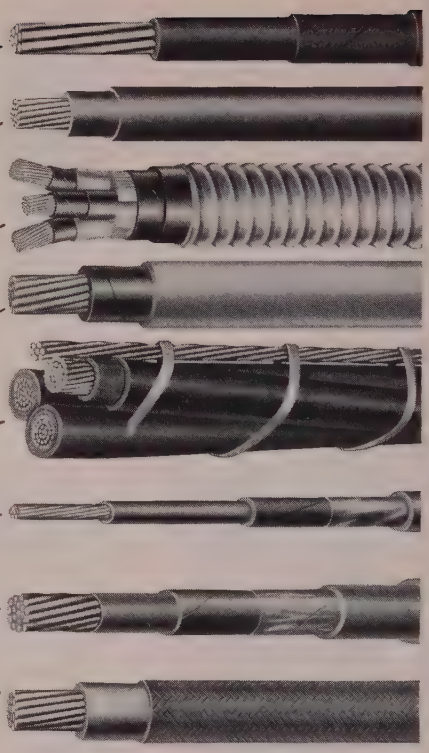
SINCE 1889 . . . FIRST IN WATER COOLERS . . . OVER 1,000,000 SOLD

2348

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

DISTRIBUTION & BRANCH CIRCUITS & FEEDER

WHEN OPERATIONS REQUIRE	SELECT
75°C Wet or Dry Building Wire	Collyer RHW
75°C Wet or Dry RR Power Cable	Collyer Style RR (RHW Insulation)
85°C Wet or Dry-RR Ozone Resisting Power Cable	Collyer Style RR (Butyl Insulation)
75°C Power Cable, Dry Locations	Collyer VCB with or without interlocking armor
75°C Power Cable, Wet or Dry Locations	Collyer VCL with or without protective neoprene sheath
85°C Overhead Ozone Resisting Power Cable	Collyer Self-Supporting Aerial Cable (Butyl Insulation)
110°C Power Cable, Dry Locations	Collyer Type AVA
110°C Power Cable	Collyer Type AVL
150°C Power Cable	Collyer Silicone Power Cable



When the call is for cable...
call COLLYER

SERVICE CABLE

75°C Wet or Dry Service Cable	Collyer SE Style U or A
75°C Wet or Dry Overhead Service Cable	Collyer Neutral Supported Service Cable

SWITCHBOARD WIRE

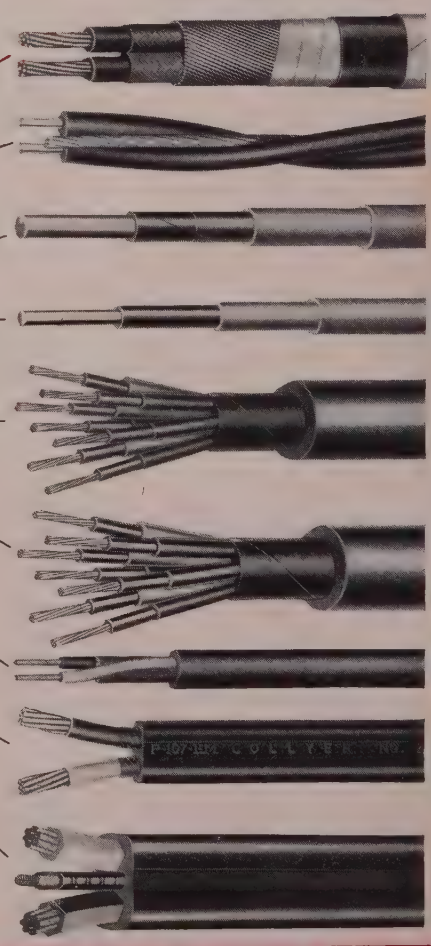
90°C Switchboard Wire	Collyer Type AVB
90°C Switchboard Wire	Collyer Type TA

CONTROL CABLE

75°C Wet or Dry Small Diameter Control Cable	Collyer C-141 (Polyethylene, Nylon, PVC)
75°C Wet or Dry RR Ozone Resisting Control Cable	Collyer RR Control Cable (Oil Base Insulation)

PORTABLE CABLES

Portable Power Cords	Collyer SJ or SJO, Light Duty Collyer S or SO, Heavy Duty
Heavy Duty, Without Ground	Collyer Type W
Heavy Duty, With Ground	Collyer Type G



for complete details, write

Collyer Insulated Wire Company
265 Roosevelt Avenue
Pawtucket, Rhode Island

TOP QUALITY PRODUCTS...

Distributed by Graybar

PRETESTED HOLDING POWER

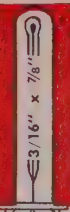
USE DIAMOND DHD® HAMMER DRIVE ANCHORS

Closed Aluminum Anchor and Galvanized Nail Assembly. Sizes range 3/16" to 1/2" dia. - 7/8" to 3" length.

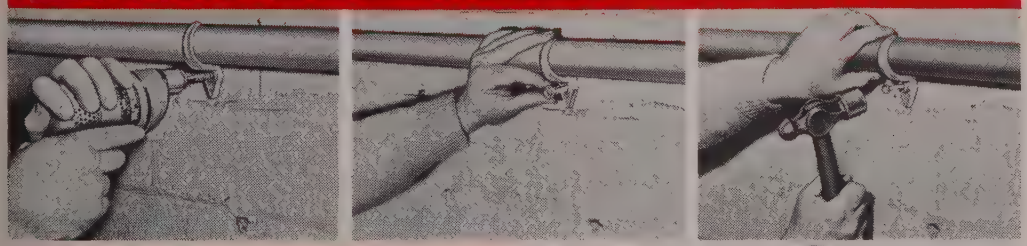
WHERE HOLDING POWER COUNTS . . . USE THIS EXPANSIVE ANCHOR . . . for ALL KINDS of MASONRY

- Nail Type
- Vibration Proof
- Rust Proof

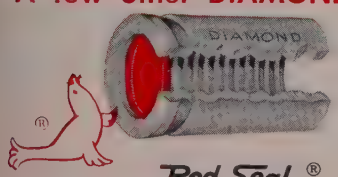
TRIAL OFFER: Write for catalog sheet and trial samples.



ONLY 3 STEPS TO INSTALL IN 20 SECONDS

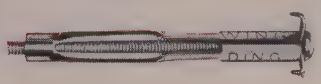


A few other DIAMOND ANCHORS



Red Seal ®

Machine Screw Anchors
Inexpensive Calking Anchor. Red fibre disc keeps dust out of threads. Sizes 10-24 & 1/4" - 20.



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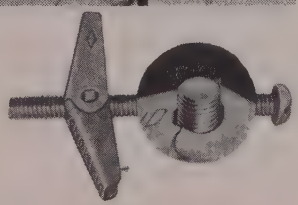
MADE IN U.S.A. U.S. PAT. NO. 2,762,252

ANCHORS
For hollow walls or doors. 3 sizes using 1/4" holes, 1 size using 5/16" hole. One piece construction.



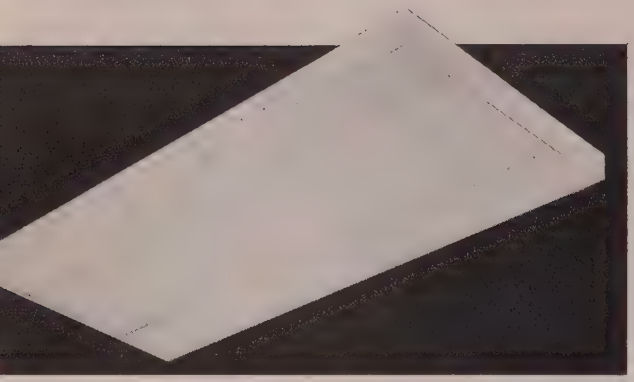
Diamond "Spring" Toggle Bolts
Wings butt together, do not bear against bolt. Diameters 1/8" to 1/2", lengths from 2" to 6".

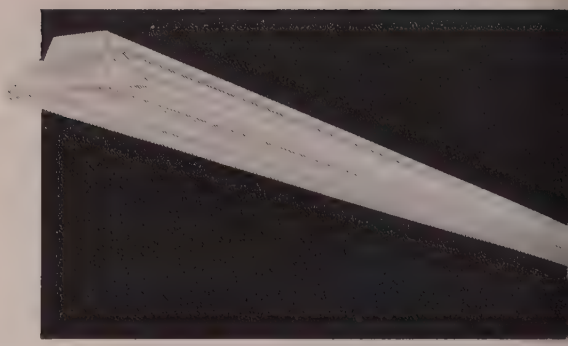
700 lbs.

DIAMOND EXPANSION BOLT CO., INC.
GARWOOD, NEW JERSEY

TOP QUALITY PRODUCTS . . .

Distributed by GraybaR



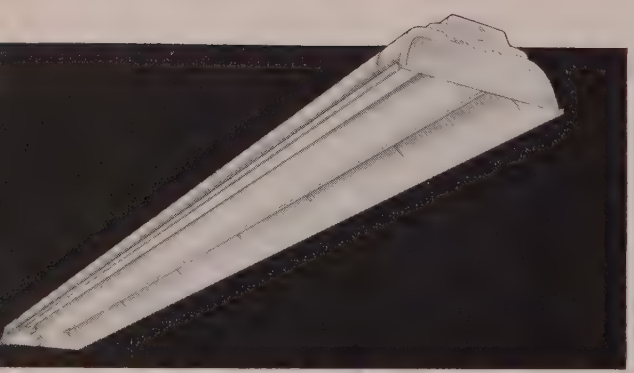


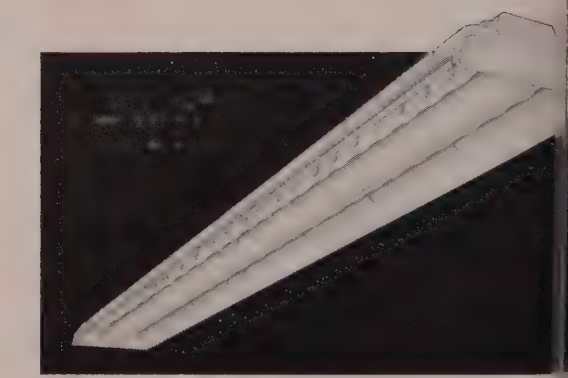
HOW TO provide modern appearance plus surface-mounting flexibility:

DAYLUME® Only 3¼ inches thin! Most complete line of surface lighting elements available today. 50 models, 5 enclosures, for extraordinary light control and layout possibilities.

HOW TO get top lighting design and ciency on a limited budget:

FAIRVIEW Day-Brite appearance, perform and quality at about half the price you'd e to pay! First full 8-foot prismatic enclosure 8-foot Slimline or 4-foot Rapid-Start lamps





HOW TO create a glare-free environment where seeing tasks are critical:

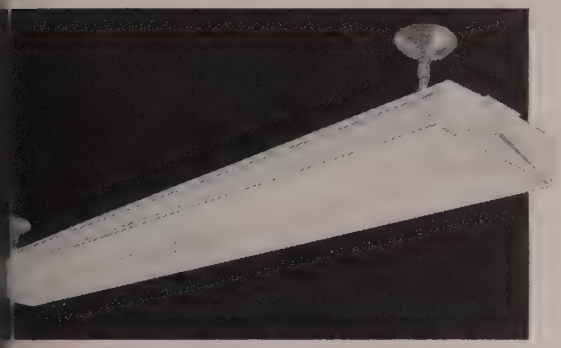
CFI®-25 Day-Brite Comfort For Industry fixtures, with 8-foot Slimline or 4-foot Rapid-Start lamps, wipe out harsh ceiling contrasts—make plants look brighter, more cheerful.

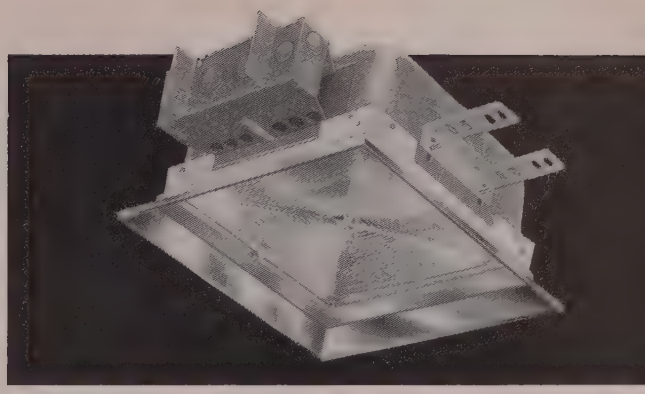
HOW TO deliver Comfort For Industry ing at lowest total cost:

CFI®-30 POWER-GROOVE Compare insta operating and total annual owning costs to yourself that this is today's best inc lighting value. 25% uplight balances brig

TOP QUALITY PRODUCTS

Distributed by Graybar





W TO achieve more light with fewer tures:

OVER-GROOVE LUVEX® Day-Brite adds new atility to this popular classic for use with a high-output lamps. All metal fixture with vers, die-formed and welded construction.

HOW TO enhance architectural design with sparkling incandescent accents:

UNI-FRAME® 24 combinations accommodate 100- to 300-watt lamps. Choice of Pyrex* prismatic lens or diffusing glass bowl. 10- and 12-inch sizes, three finishes, optional splay trim.

*Reg. trade name, Corning Glass Works

WHAT'S YOUR LIGHTING PROBLEM?

Worker productivity? Fewer rejects? Higher sales goals? Unusual esthetic considerations? Budget or structural limitations?

Whatever the lighting problem, you are almost certain to find the solution in Day-Brite's complete line. There's a Day-Brite lighting system to meet nearly every commercial and industrial requirement. Lighting to complement every decor. Lighting in today's higher recommended intensities. Quality lighting in every price range.

See for yourself—see your Graybar man for the *facts* and *fixtures!*

B-193

DAY-BRITE

Day-Brite Lighting, Inc.
St. Louis 15, Missouri

Distributed by GraybaR

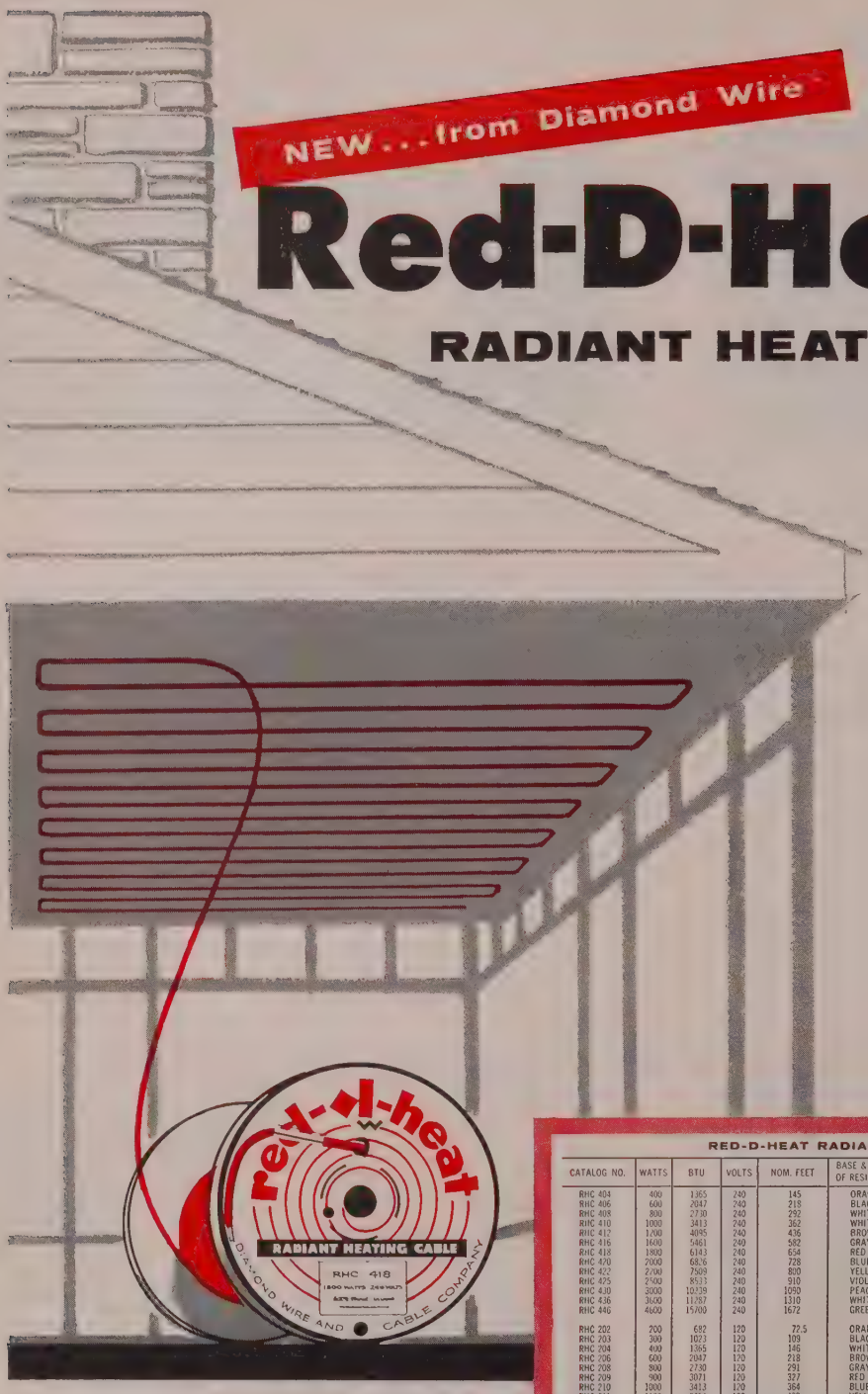
NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

TOP QUALITY PRODUCTS ... Distributed by GraybaR

NEW . . . from Diamond Wire

Red-D-Heat®

RADIANT HEATING CABLE



Now . . . an important addition to a dependable line of wire and cable, *Red-D-Heat* joins the family of quality products that have already established Diamond as a respected and accepted supplier to the construction field. Red-D-Heat is available in a full line of nylon and thermoplastic insulated radiant heating wire . . . manufactured under strict quality control to deliver "full capacity."

Each unit of Red-D-Heat is packaged on non-returnable metal reels in a definite length to supply a specific wattage at standard voltage rating. Every unit is equipped with an 8-foot firmly spliced non-heating nylon lead, and all wire is color coded and tagged to identify wattage and voltage.

RED-D-HEAT RADIANT HEATING CABLES

CATALOG NO.	WATTS	BTU	VOLTS	NOM. FEET	BASE & PRINT COLOR OF RESISTANCE WIRE	NON HEATING LEADS – 8 FT TW—NYLON JACKET	CABLES PER CARTON	SHIPPING WEIGHT PER CARTON
RHC 404	400	1365	240	145	ORANGE (BLK)	Red #14	8	11
RHC 406	600	2047	240	218	BLACK (WHI)	Red #14	6	14
RHC 408	800	2730	240	292	WHITE (BLK)	Red #14	6	17
RHC 410	1000	3413	240	362	WHITE (RED)	Red #14	6	20
RHC 412	1200	4095	240	436	BROWN (BLK)	Red #14	6	20
RHC 416	1600	5461	240	582	GRAY (BLK)	Red #14	6	26
RHC 418	1800	6143	240	654	RED (BLK)	Red #14	6	29
RHC 420	2000	6826	240	728	BLUE (BLK)	Red #14	6	32
RHC 422	2200	7509	240	800	YELLOW (BLK)	Red #14	6	35
RHC 425	2500	8533	240	910	VIOLET (BLK)	Red #14	6	47
RHC 430	3000	10239	240	1090	PEACH (BLK)	Red #14	6	47
RHC 436	3600	11267	240	1310	WHITE (BLU)	Red #12	6	65
RHC 446	4600	15700	240	1672	GREEN (BLK)	Red #12	6	104
RHC 202	200	682	120	72.5	ORANGE (BLK)	Yellow #14	6	4.5
RHC 203	300	1023	120	109	BLACK (WHI)	Yellow #14	6	8
RHC 204	400	1365	120	146	WHITE (BLK)	Yellow #14	6	11
RHC 206	600	2047	120	218	BROWN (BLK)	Yellow #14	6	11
RHC 208	800	2730	120	291	GRAY (BLK)	Yellow #14	6	11
RHC 209	900	3071	120	327	RED (BLK)	Yellow #14	6	14
RHC 210	1000	3413	120	364	BLUE (BLK)	Yellow #14	6	17
RHC 211	1100	3754	120	400	YELLOW (BLK)	Yellow #14	6	17
RHC 212½	1250	4766	120	455	VIOLET (BLK)	Yellow #14	6	17
RHC 215	1500	5122	120	545	PEACH (BLK)	Yellow #14	6	23

Write today for information describing the complete Red-D-Heat line.

Trade Mark ®

DIAMOND

WIRE and **CABLE** Company

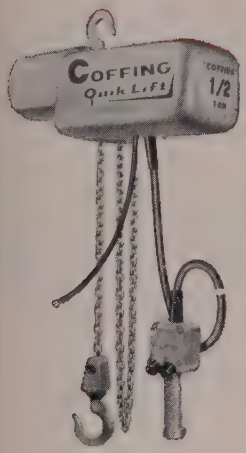
Sycamore, Illinois

WAREHOUSES: Pittsburgh • Cleveland • Minneapolis • Denver • Dallas • Atlanta

TOP QUALITY PRODUCTS

Distributed by Graybar

Coffing Hoists for Safety and Economy

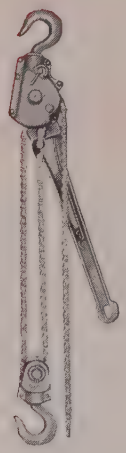


Coffing Quik-Lift Electric Hoists

New coil chain line features push-button controls on all models. Made with lightweight aluminum castings, they are available in 20 models ranging from ¼ to 2 tons in capacity. For other lifting speeds and larger capacities, we offer the Quik-Lift Series "S".

Super Power Coil Chain Hoists

Compound lever and ratchet-and-pawl construction make them lightest, safest, most efficient hoists in their class. Six models in capacities from 1½ to 5 tons—1½ and 3 ton in aluminum as well as malleable iron.



Safety Pull Roller Chain Hoists

Ratchet-and-pawl construction assures safe operation, and "Safety Valve" handle gives before any load-bearing part can fail—warning operator. Ten models in capacities from 1½ to 15 tons.

Challenger Spur Gear Hoists

Light-weight and dependable, the Challenger is available in ½ and one ton capacities. Durable construction and sealed-in lubrication reduce maintenance costs to a minimum.

Mighty-Midget Pullers

Light and compact—500 pound model weighs but 6½ pounds, 1000 pound model but 9½. Handle can be used either as a lever or a high speed crank.

Duff-Norton Jacks Save Time, Energy and Money

Pole-Pulling Jacks

Duff-Norton pole-pulling jacks will pull or straighten utility poles without laborious digging. Hinged channel base permits jack operation at an angle or upright as required. Service need not be interrupted when these jacks are used.

Cable Reel Jacks (single action)

Jacks are equipped with adjustable cable reel lift incorporating a steel hook which can be placed at any point on the lifting rack. Reels of different diameters can be picked up at any height. Five ton model 524MCR is especially adaptable to warehouse use for handling cable, wire, hemp rope, leather belting and the like.

DUFF-NORTON

Duff-Norton Company

MAIN PLANT AND GENERAL OFFICES: PITTSBURGH 30, PA.

CANADIAN PLANT: TORONTO, ONT.

Coffing Hoist Division • DANVILLE, ILLINOIS

TOP QUALITY PRODUCTS . . .

Distributed by Graybar

This is a distributor.

"Round the clock service and technical teamwork pay off in 'Missile Town'"

Meet Paul W. Thompson, manager of Graybar Electric Company's Huntsville, Alabama branch office, who uses service and technical teamwork to keep pace with the missile boom in "The Space Capital of the Universe."

"The advent of the space age has changed the face of this whole area. Here at Huntsville, giant Redstone Arsenal and its rocket and missile programs have brought a soaring increase in population—from 12,000 to 70,000 in the space of only four years. We do plenty of business with the scientists at the Arsenal, but the biggest challenge has been in keeping up with the pressing demand for new school buildings that's come with the phenomenal population growth."

"Getting the school business is a full time selling job," says Thompson. "I spend more time with contractors and architects than with anybody. We've been pretty successful in getting them to think Graybar when they think signaling systems, clock systems, or anything electrical. It's not the kind of relationship you build up overnight—we've built it on a reputation for service, quality, confidence and technical help."

TOP QUALITY PRODUCTS . . .

Distributed by Graybar

Thompson (center), Bill Seale, manager of Miller Electric Co. (right), and Dick Kingston, Edwards regional engineer (seated), work out the best method of tieing-in a new Edwards clock system for a recently built wing of an old school. Here, the problem was an existing bell system much reworked and improvised.

"I rate technical help way up on the list," Thompson says. "We've found this pulls a lot of weight with the contractor. We want them to know they can always count on us for assistance with the knotty problems—just as we know we can count on manufacturers' local technical reps, like Dick Kingston of Edwards, to fill out the technical team that licks these problems."

One of the fastest growing electrical contracting firms in Huntsville is Miller Electric Co. Manager Bill Seale has this to say about Graybar's service: "Graybar can get me anything I want—and provide the kind of assistance we need—without a lot of wasted time running around. We've found that Paul Thompson or any of his staff are available any hour of the day or night to help us with tough installation or parts problems."

"We know we can count on Graybar for service—real service," Seale says. "Many times we've been faced with a crisis and have had to call Paul Thompson the day before we needed figures for our bid—he always comes through. Take the Madison Pike High School job—here's where teamwork between contractor, supplier, and manufacturer really paid off.

We all worked together on specifications, bids, supplies, and installation. Dick Kingston, the Edwards rep, was due for the final check out on the installation—an extensive clock system—on a Thursday. Then the schedule was changed. The inspectors were due *Wednesday*. I called Graybar on Monday. Thompson checked with Kingston in the Edwards Atlanta office and he was on the spot Tuesday morning. The system checked out fine and everyone was happy—most of all, the Madison High Principal. We've got four school jobs going right now that are going to have Edwards systems supplied by Graybar. This is a team that's too good to break up!"

Thompson, Seale, Kingston, and Joe Quarles, Miller Electric's Electrical Superintendent (right), check out Edwards program system with Madison Pike High School Principal, Louis J. Morris (center).

"Quality, confidence, service, and technical help—most of all teamwork by distributor, contractor, and manufacturer—that's the formula that's paying off in Missile Town!"

The Edwards Company believes that distributors have an important but sometimes under-rated job to do in the electrical industry. Often we run across men in distributing like Paul Thompson of Graybar Electric Company who are doing their job very well indeed. We're glad to be able to relay their ideas.

EDWARDS

Specialists in signaling since 1872

CONTROL • COMMUNICATION • PROTECTION

Edwards Company, Inc., Norwalk, Connecticut
(In Canada: Edwards of Canada, Ltd, Owen Sound, Ontario)

TOP QUALITY PRODUCTS . . . Distributed by Graybar

Plenty of Slip—

Y-ER EAS (TRADE MARK) Wire Pulling Lubricant

The original Wire Pulling Lubricant.
Gives Slip to Lead, Rubber, Braid or
Synthetic Covered Cables.

Write for descriptive booklet

ELECTRO COMPOUND CO.

4149 West 150th Street, Cleveland 35, Ohio

TOP QUALITY PRODUCTS

Distributed by Graybar

ore contractors endorse **EFCOR** *products because...*

CONFIDENCE

IS BUILT ON QUALITY, SERVICE, PERFORMANCE

Actually, "confidence" covers all three points . . . product quality, alert service, dependable performance. Efcor is industry's growing choice as the wide line source. There are now more than 1500 quality engineered products . . . more are on their way.

Efcor engineered products reduce installation time, raise efficiency . . . assure product satisfaction.

Have you reviewed Efcor's wide line lately? Catalog on request . . . write today.

Efcor®

ELECTRICAL FITTINGS • SWITCH & OUTLET BOXES
ELBOWS, NIPPLES, COUPLINGS • "WIRE GLIDE"®

sold only through electrical distributors

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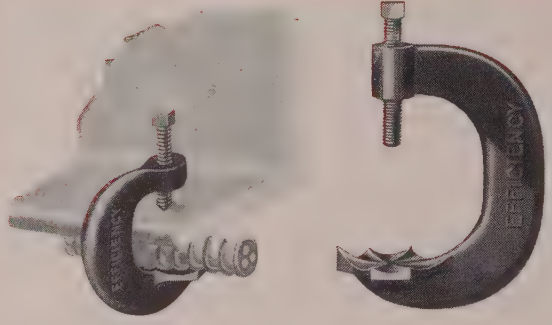
TOP QUALITY PRODUCTS Distributed by GraybaR

Efficiency

SUSPENSION DEVICES

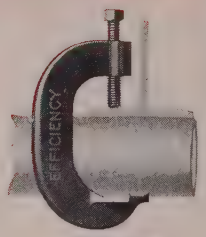
ARE TIME AND COST SAVERS

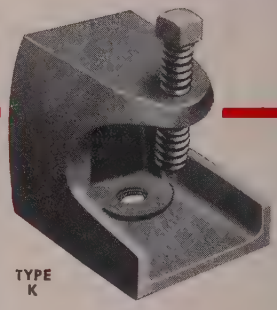
By eliminating the need for punching, drilling or burning through beams in order to hang electrical mountings . . . Efficiency Suspension Devices can save you time and expense on practically every construction job.



CONDUIT HANGERS

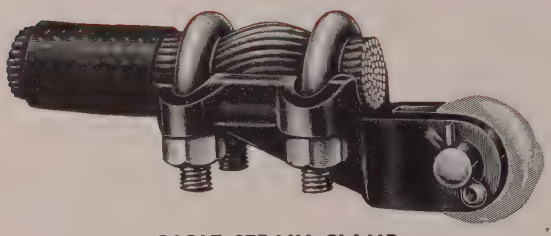
Correctly designed for carrying armored cable or ½" to 2¼" pipe along open steel construction. Radiating r'dges and the five point gripping surface keeps the pipe suspended dead center, with the set screw above permitting the cable or pipe to be carried at any angle. Made of highest quality malleable iron.





TYPE K

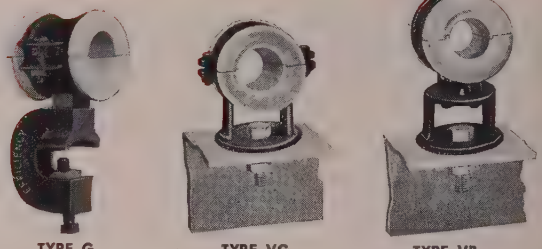
ADJUSTABLE INSULATOR SUPPORT



CABLE STRAIN CLAMP

Capable of withstanding a direct pull of over 12,500 lbs. before slipping, this clamp can be furnished either with eye or clevis. Three clamp sizes accommodate all cable sizes from 1/0 to 1,500,000 c.m. Constructed of malleable iron, this clamp has a high ridge across the center of the cable channel and a U-bolt at each end.

BUSHING SUPPORTS

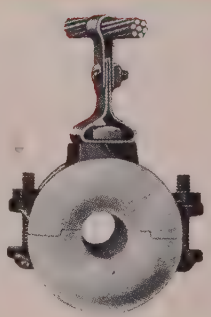


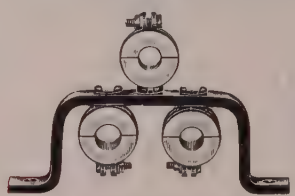
TYPE G TYPE VG TYPE VB

Designed to eliminate the drilling of holes for mounting, these supports are adjustable to any angle. Made of malleable iron with highest quality split porcelain, they are furnished for AC-DC service to handle $\frac{6}{16}$" to 2⅜" cable. Type G is clamp-mounted while Type VB and VG bolt mounted through its circular base.

BUSHING MESSENGER SUPPORT

This support is designed to suspend wire or cable from messengers where beam mounting is not possible. This support is a combination of our Type G Bushing Support with strip steel messenger attachment. Furnished complete with malleable iron support, steel messenger attachment and all bolts, as illustrated.





NESTED BUSHING RACKS AND SUPPORTS

Simply and compactly designed to carry conductors equidistant from center to center. Each bushing is a separate unit, allowing independent installation of each cable line. Available in 2, 3, 4, 5 and 6 bushing racks.

BUSHING RACKS AND SUPPORTS

Available in 2, 3, 4, 5 and 6 bushing racks for AC or DC service. Only a single bolt is required to support the bushing and clamp the support to the rack. For $\frac{5}{16}$" to 2⅜" wire sizes.

EFFICIENCY ELECTRIC AND MANUFACTURING COMPANY

Write for Catalog

EAST PALESTINE, OHIO

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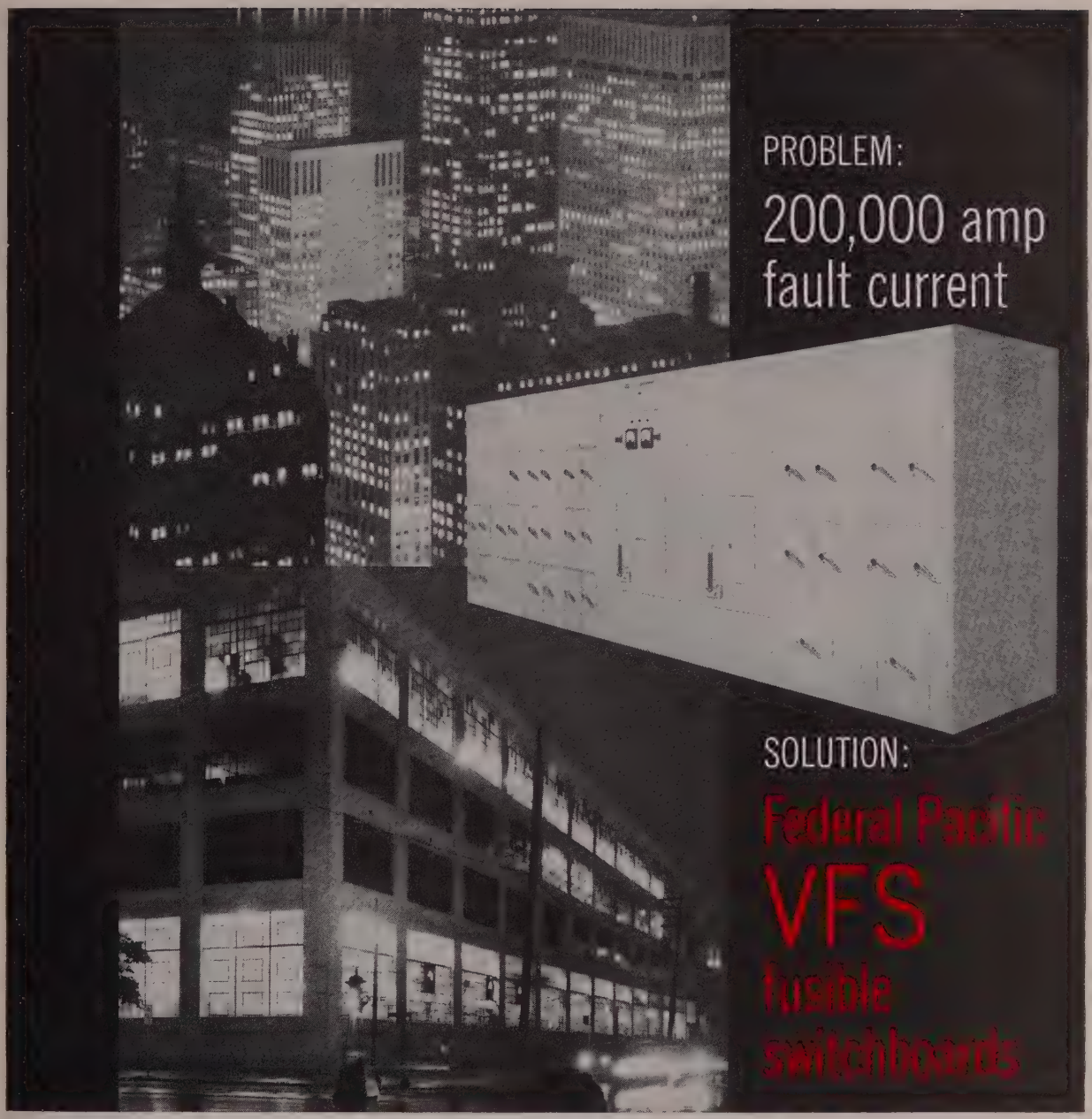

Federal Pacific Type VFS Switchboards anticipate the increasing power requirements of expanding commercial and industrial users —and the resulting higher fault currents. ■ Fusible switch units and current limiting fuses give full protection on fault currents up to 200,000 amperes. ■ All switches interrupt at least twelve times rated current at full rated voltage. ■ Isolated switch and bus sections.

YOU GET GREATER FLEXIBILITY FOR EXPANSION

■ Main bus rated up to 5000 a. ■ Modular construction for quick, easy interchangeability or additions. ■ Front accessibility simplifies maintenance and inspection. ■ Available with a full line of QMQB switches and SP-1 Service Protectors through 5,000 amps.

PLUS THE INDUSTRY'S MOST RUGGED CONSTRUCTION

■ High impact bus supports. ■ Steel enclosed. ■ Prepunched bolted channel frame.

For complete information write for Bulletin 2100, Federal Pacific Electric Company, General Offices: Dept. 433, Newark 1, New Jersey—The Best in Electrical Control, Distribution and Power Equipment.

FPE

FEDERAL PACIFIC ELECTRIC COMPANY

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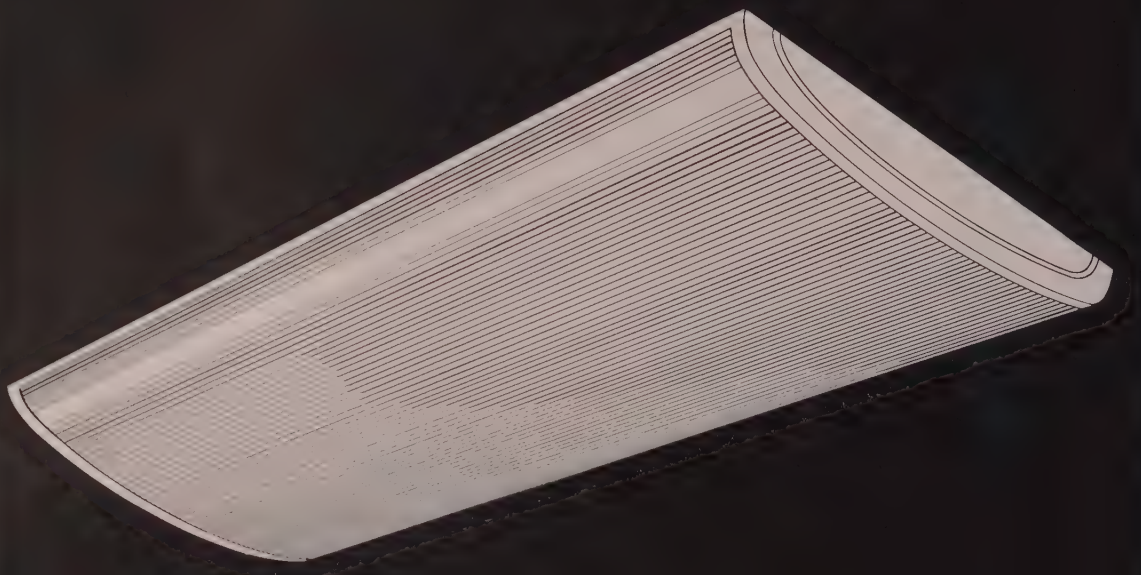

Ultra-Lux...distinctive style and performance in ultra-shallow two or four-lamp units

Send for brochure **GARCY LIGHTING** DIV. OF GARDEN CITY PLATING & MFG. CO.
2475 ELSTON • CHICAGO 47, ILLINOIS

TOP QUALITY PRODUCTS

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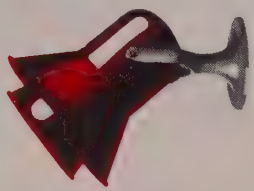
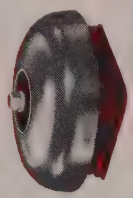
SIGNAL *leadership*

VIBRATONE HORNS

CHIMES



INDUSTRIAL SIRENS



HEAVY DUTY BELLS

#271 BEACON RAY

CONTRACTORS WHO KNOW—

Acclaim the VIBRATONE horn as the most advanced signal. Even our competition (reluctantly) admit its superiority and prominent systems-designers have made it their standard.

CONTRACTORS WHO KNOW—

Recommend VIBRATONES when vibratory horns, buzzers, or howlers are needed, and often as a substitute for bells because they do a better job.

CONTRACTORS WHO KNOW—

Know that VIBRATONE Horns are—
More compact, powerful and dependable, less expensive to stock, install and maintain. Better looking, better performing and better sounding.

CONTRACTORS WHO KNOW—

Always turn to FEDERAL for other high quality signals, available in the greatest variety—resonating horns, motor driven horns, airhorns, sirens, bells and revolving Beacon Ray warning lights.

Don't take our word for it!
Get in the know!
Ask your distributor.
Ask for our Catalog #100.

RESONATING HORNS

AIR HORNS

FEDERAL SIGN and SIGNAL Corporation

13626 S. Western Ave., Blue Island, Ill.

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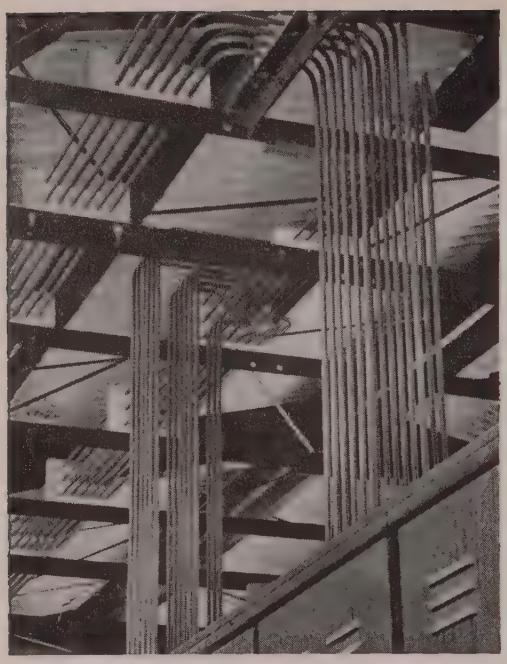
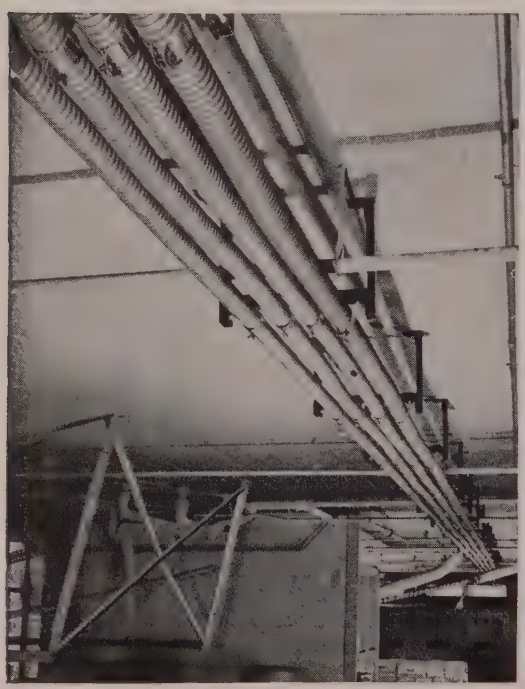
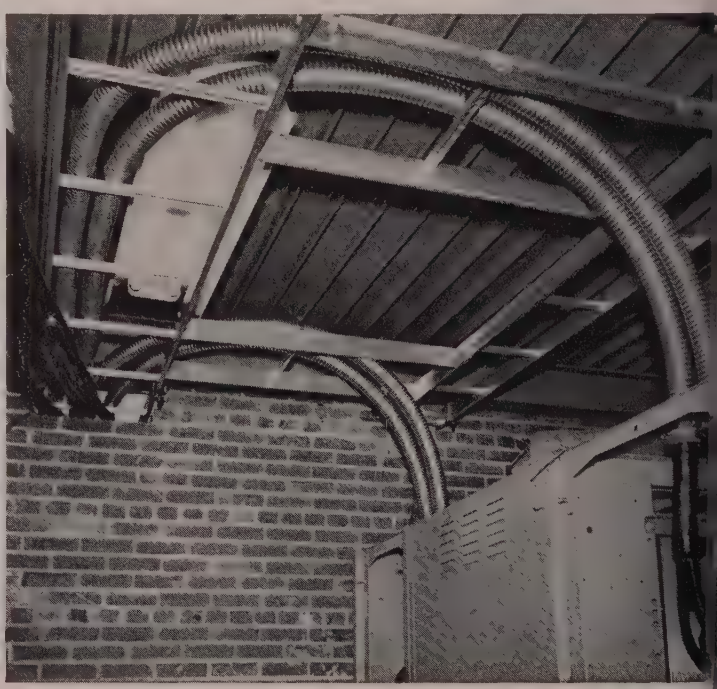


the right combination for

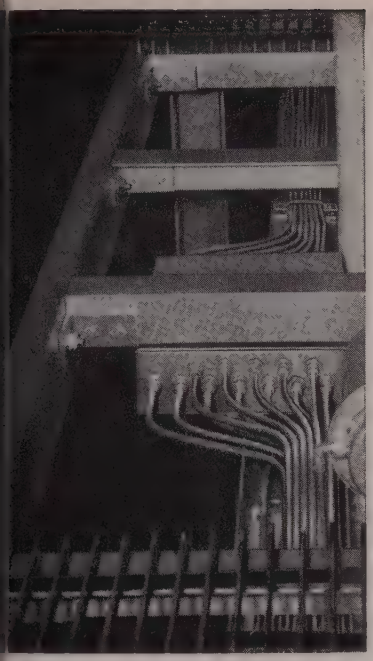




ONLY GENERAL CABLE MANUFACTURES BOTH TYPE MI AND INTERLOCKING ARMORED CABLES

TOP QUALITY PRODUCTS . . .

Distributed by GraybaR



type mi cable

for power distribution, control and lighting circuits

TYPE MI CABLE has solid copper conductors and sheath separated by highly compressed inorganic insulation! Just about indestructible, yet it trains easily over and around obstructions. Naturally it needs no protection: just train it and terminate it. MI is compatible with all other wiring systems. It is completely resistant to moisture, age, nearly all chemicals, temperatures up to 185°F with standard terminations, 482°F with special terminations; and it is approved for use in hazardous areas. It will last forever.

industrial power

Type MI Cable and Interlocking Armored Cable work together to lower installation costs, minimize space requirements, provide maximum flexibility and accessibility in your cable systems.

inter-locking armored cable

for feeder circuits

GENERAL CABLE'S Interlocking Armored Cable combines flexibility with the mechanical protection normally afforded by metallic conduit, yet has the same current rating as cable in free air. It can be trained to fit the contours of buildings and surrounding equipment and provides a neat, compact installation. It is available in bronze, aluminum and steel and may be applied over most cable insulations in the voltage ranges recommended by industry standards. Protective coverings are available to combat environmental conditions which might cause pitting or corrosion of the interlocking armor.

GENERAL CABLE CORPORATION

730 Third Ave.
New York 17, N. Y.

GENERAL CABLE

TOP QUALITY PRODUCTS . . .

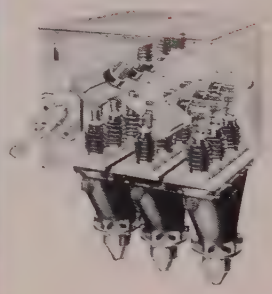
Distributed by Graybar

equipment of proved dependability

LOAD-BREAK OIL SWITCHES provide cable system flexibility

Reduce overtime work on system maintenance. Sectionalize your distribution system with Type "RA" load-break oil switches. Isolate cable faults and restore service by switching loop or duplicate feeders—manually or automatically.

Send for series "D" bulletins.

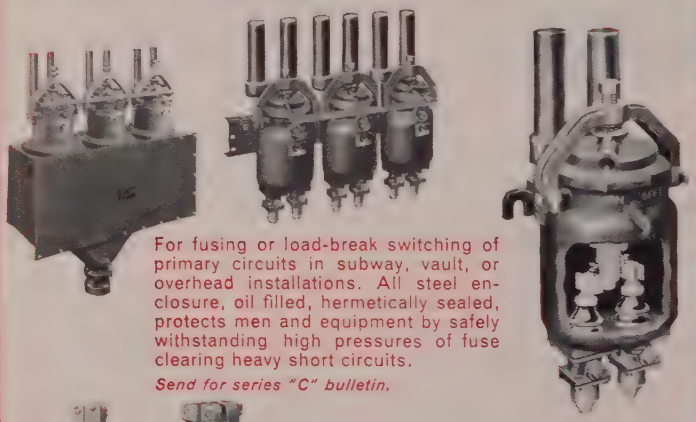


SPLICING KITS, pre-engineered to save time and money

Each item supplied in the correct quantity for a properly designed joint. Time and expense of securing various items from different sources are saved. Accumulation of dead stock is avoided; no waste. All materials kept clean and ready for use. Each splicing kit labeled for easy identification. Cable splicing costs can be determined accurately.

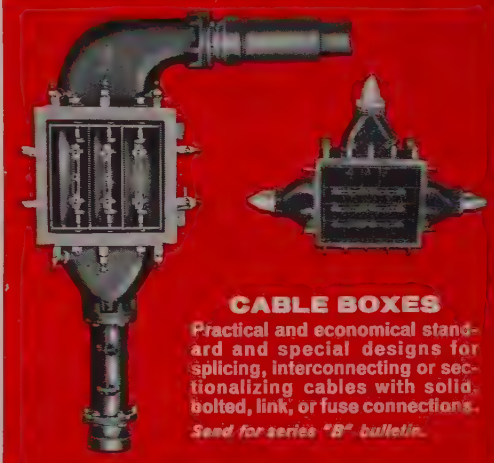
Send for series "J" bulletins.

OIL FUSE CUTOUTS



For fusing or load-break switching of primary circuits in subway, vault, or overhead installations. All steel enclosure, oil filled, hermetically sealed, protects men and equipment by safely withstanding high pressures of fuse clearing heavy short circuits.

Send for series "C" bulletin.



CABLE BOXES

Practical and economical standard and special designs for splicing, interconnecting or sectionalizing cables with solid, bolted, link, or fuse connections.

Send for series "B" bulletin.

POTHEADS for every high voltage cable

Sodertite, capnut, disconnecting. Solder, clamp, or press-style connectors for copper conductors; press-style for aluminum conductors. Wiping sleeve or stuffing box cable entrance seals. Conduit and armor fittings.

For detailed information on the complete G & W line send for series "A" bulletins.

G&W ELECTRIC SPECIALTY CO.

3500 W. 127th Street, Blue Island, Ill. Representatives in principal cities of N. and S. America

Canadian Mfgr.: Powerlite Devices, Ltd., Toronto

TOP QUALITY PRODUCTS

Distributed by GraybaR

HOLOPHANE

Prismatic

REFLECTORS

Better Light
Lower Cost

One of many important GRAYBAR Jobs—Charlotte (N.C.) Pipe & Foundry Co.

- ***Prismatic Control assures Greatest Utilization of Light***
- ***High Output from Long Life Mercury Vapor Sources***
- ***Low Operating and Maintenance Costs . . .***

Where so much in plant output, safety and visual comfort depends on efficient lighting—you can depend on HOLOPHANE REFLECTORS . . . Their simplified construction provides easy installation and economical maintenance . . . Light sources are deep shielded, eliminating glare. Reflector surfaces are kept clean by upward draft action . . . Investigate how a modest investment in quality lighting can mean sustained increases in production and profits. Write for engineering data.

*T.M.

HOLOPHANE
COMPANY, INC. • *Lighting Authorities Since 1898*
342 Madison Ave., New York 17, N. Y.
THE HOLOPHANE CO., LTD., 418 KIPLING AVE. SO., TORONTO 18, ONT.

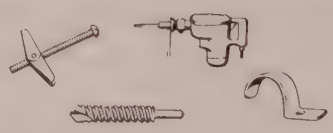
TOP QUALITY PRODUCTS . . .

Distributed by Graybar

PRIME SOURCE FOR

TOOLS

...to speed the job
...to reduce your costs
...to make sure of the best



Fastenings and Supports

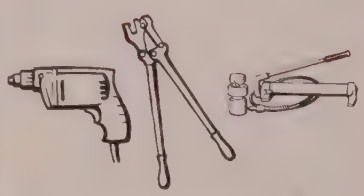
Masonry anchors, studguns and studs, masonry drills, hangers, clamps, channel and fittings, metal lumber.

Scaffolds and Platforms

Scaffolds, stages, adjustable work platforms, ladders.

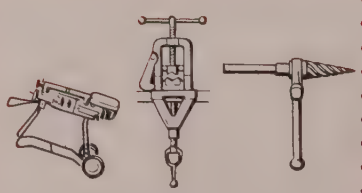
Materials Handling Equipment

Wire carts, hand trucks, conduit and wire storage.



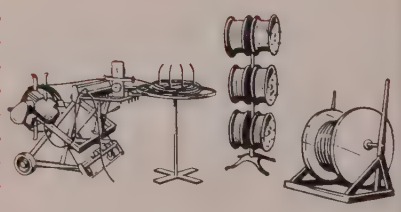
Mechanized Assembly Tools

Portable electric tools, punches, reamers, conduit benders.



Conduit and Raceway Tools

Pipe cutters and threaders, hydraulic conduit benders, portable band saws, reamers, wrenches, vises.



Cable Handling Tools

Reel trucks and carts, wire storage, wire measuring equipment, cable pullers.

TOP QUALITY PRODUCTS . . . Distributed by Graybar

For Underground Work

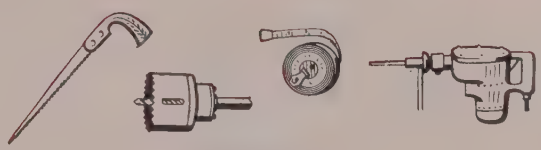
Manhole ventilators, barricades, MEN WORKING signs, pliers, grips.

Pole and Line Work Tools

Climbing tools, safety belts, pike poles, digging bars, shovels.

Temporary Power Facilities

Portable generating plants, barricades.



Alteration Tools

Drill routers, hole saws, wood chisels, cement drilling machines, extension cords, compass saws.

Maintenance Tools

Screwdrivers, hammers, gun tackers, hacksaws, steel tapes, soldering irons, voltage testers, pliers, wrenches, portable torches, electric drills.

Communication Facilities

Audio hailers, electronic wires and cables, sound and intercommunication equipment.

Tools that you buy from Graybar help do the job more quickly, more efficiently and more economically.

Graybar knows electrical equipment inside and out, knows what you *want* and need, and stocks only the tools that will give top performance for you.

Graybar is the only electrical distributor supplying tools for every type of electrical work. In the 80-page Graybar Tool Catalog for Electricians you'll find all the quality tools you need...to speed the job...to reduce your costs. For your copy, send your name and title on your business letterhead.

For contractors doing pole line construction work, there is also available a 92-page catalog listing Outside Construction Tools and Equipment. Specify if needed. 936

CALL **GraybaR** FIRST FOR

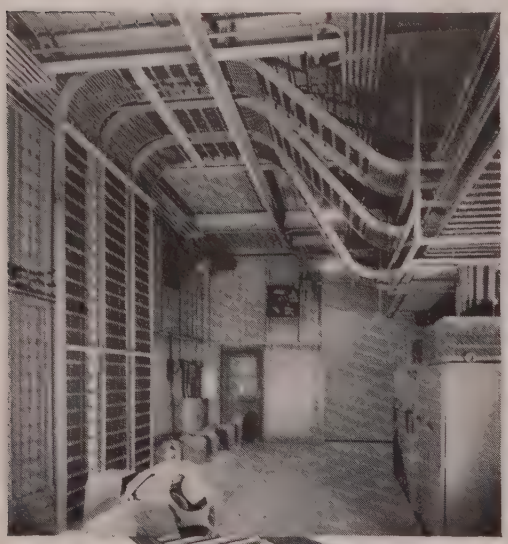
Graybar Quality Since 1869 — Everything Electrical — Graybar Electric Company

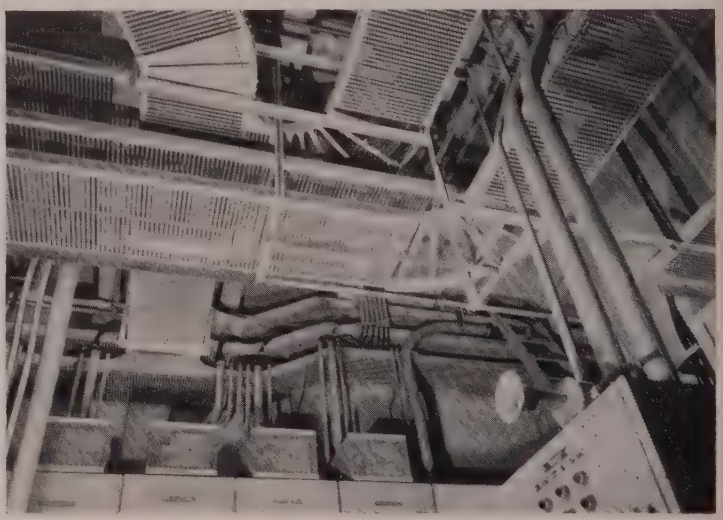
GRAYBAR ELECTRIC COMPANY, INC. • 420 Lexington Avenue, New York 17, N. Y. • IN OVER 130 PRINCIPAL CITIES

TOP QUALITY PRODUCTS . . . Distributed by Graybar

how INLAND STEEL uses GLOBE INTERCHANGEABLE TRAYS to support cables in their Indiana Harbor Plant

★ Engineered for Uniform Design and Easy Installation
★ Steel or Aluminum Construction
★ Complete Accessories for SPEEDIER Installation
★ Complete Interchangeability
★ No Sharp Edges to Damage Cables





Globe's two types of cable trays, one a ladder type and the other a basket type, to support cables, wiring and tubing have become increasingly popular because they can be used INTERCHANGEABLY at any given location depending on the type and weight of the cables to be suspended. The advantages of each type tray can be used to the fullest. Globetray, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is used for the support of communication wire, instrument tubing and control cables in automation applications.

These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants and for power distribution in all types of manufacturing processes. Send for FREE catalog giving full information and installation techniques.

PRODUCTS DIVISION
THE GLOBE COMPANY Manufacturers since 1914
4032 S. Princeton Ave., Chicago 9, Ill.

Representatives in all principal cities . . . consult the yellow pages in your phone book under "Conduits" for the one nearest you.

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

Choose from the leading line—

THE LARGEST SELECTION OF CAST IRON BOXES

HOT DIPPED GALVANIZED

HOPE Since 1919

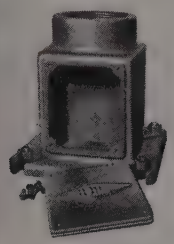
REDUCE OUTDOOR LIGHTING COSTS

Specify the *Original*

HOPE

MALLEABLE IRON METAL PIPE POLE BASE

Attractive, rugged lighting poles easily field-fabricated by combining Hope threaded bases with *standard* conduit or pressure pipe. Four base sizes permit your fixture and elevation selection for a limitless variety of installations. Base hubs tapped deep for strong, locking engagement with threaded pipe. Ample chamber for stubbing conduit, splicing, grounding.



H42200 2"
H42250 2½"
H42300 3"
H42400 4"

Bases also available with weatherproof 3 pole receptacle covers, 110v. or 208v., or both.

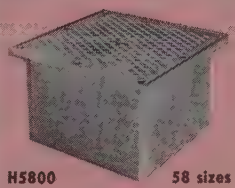
HOPE

HOPE ELECTRICAL PRODUCTS CO.

27 Long Ave., Hillside, N. J.
ELizabeth 4-7837

HUNDREDS OF TYPES AND SIZES

FLUSH MOUNTED NEMA IV WEATHERPROOF

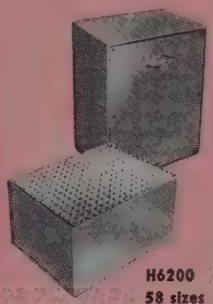


H5800 58 sizes

SIDEWALK BOX WITH CHECKERED NON-SKID COVER

H7000
60 sizes

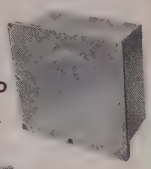
FLANGED RECESSED COVER BOXES, PLAIN OR CHECKERED COVER



H6200
58 sizes

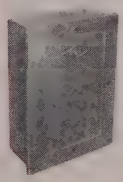
INTERNAL FLANGED WITH PLAIN OR CHECKERED COVER

SURFACE MOUNTED NEMA IV WEATHERPROOF



H8000
92 sizes

FLAT FLANGED COVER WITH WIDE GASKET

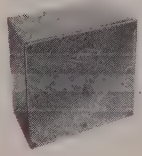


H2200
134 sizes

OVERLAP COVER WITH RETAINED GASKET

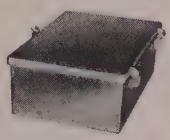
H3200
138 sizes

HINGED COVER, WITH WING NUT CLASPS, RETAINED GASKET



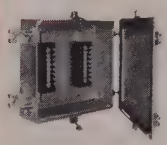
H1200
172 sizes

PLAIN SCREW COVERS



H3500
50 sizes

PIN HINGED COVER WITH SINGLE WING CLASP



H3200-T
17 sizes

TERMINAL CABINETS FOR THERMOCOUPLES OR CONTROL

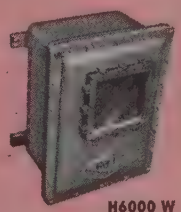
EXPLOSION RESISTING NEMA VII CLASS I GROUP D

H6000 118 sizes

JUNCTION AND APPARATUS BOXES FOR HAZARDOUS VAPOR LOCATIONS

H6000 S
4 sizes

SAFETY SWITCHES FOR HAZARDOUS LOCATIONS, 30, 60, 100, 200 amp. to 600v.



H6000 W
Twelve window sizes

SQUARE OR RECTANGULAR, FOR METERING, INSTRUMENTATION

Boxes can be supplied to your specifications with Drillings • Tappings • Five Thread Bosses • Mounting Lugs • Special Gaskets • Electrical Apparatus • Many types can be modified to meet special conditions.

For full information on the entire box line, REQUEST YOUR HOPE CATALOG TODAY

Completely illustrated • Full dimensional and technical data

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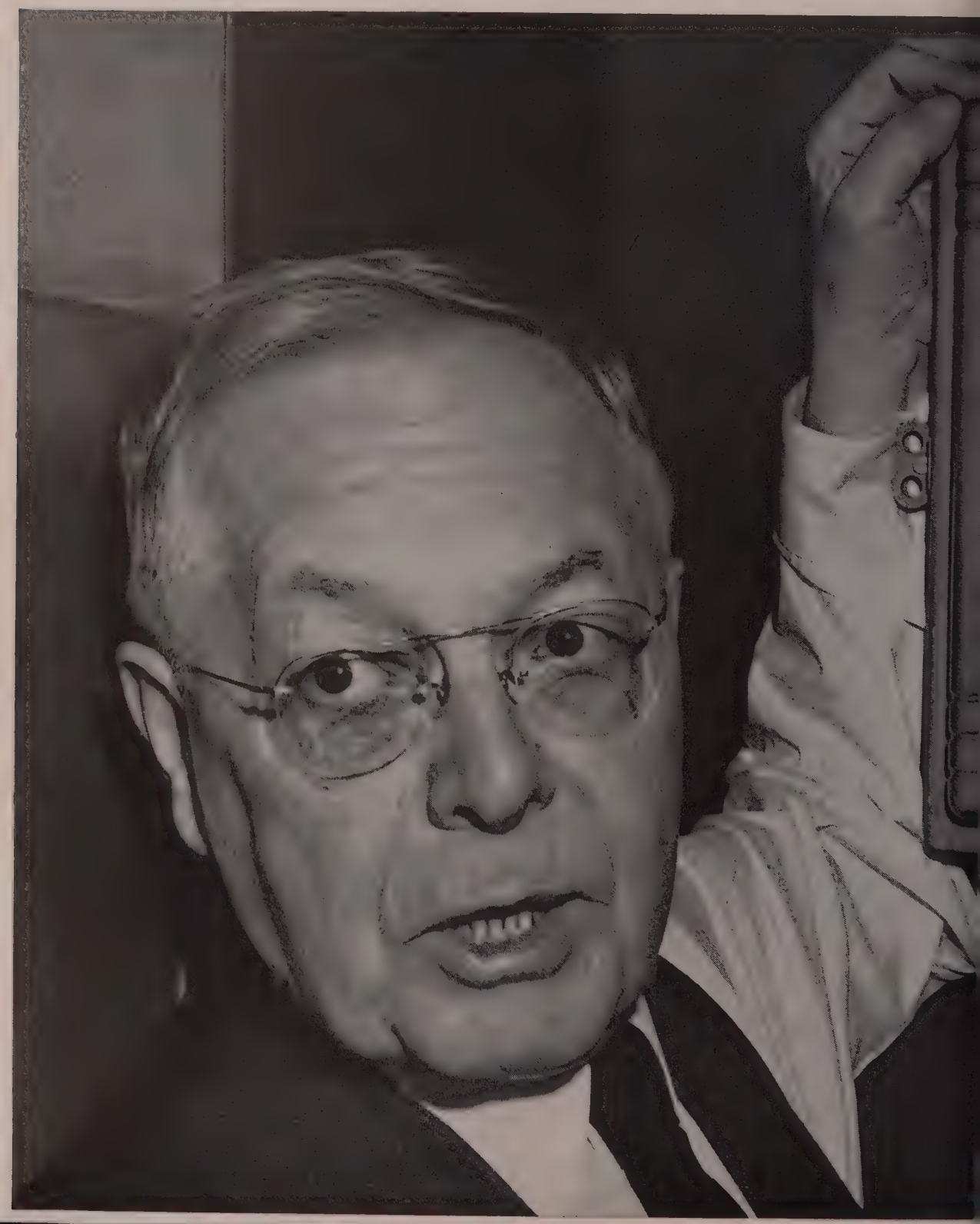
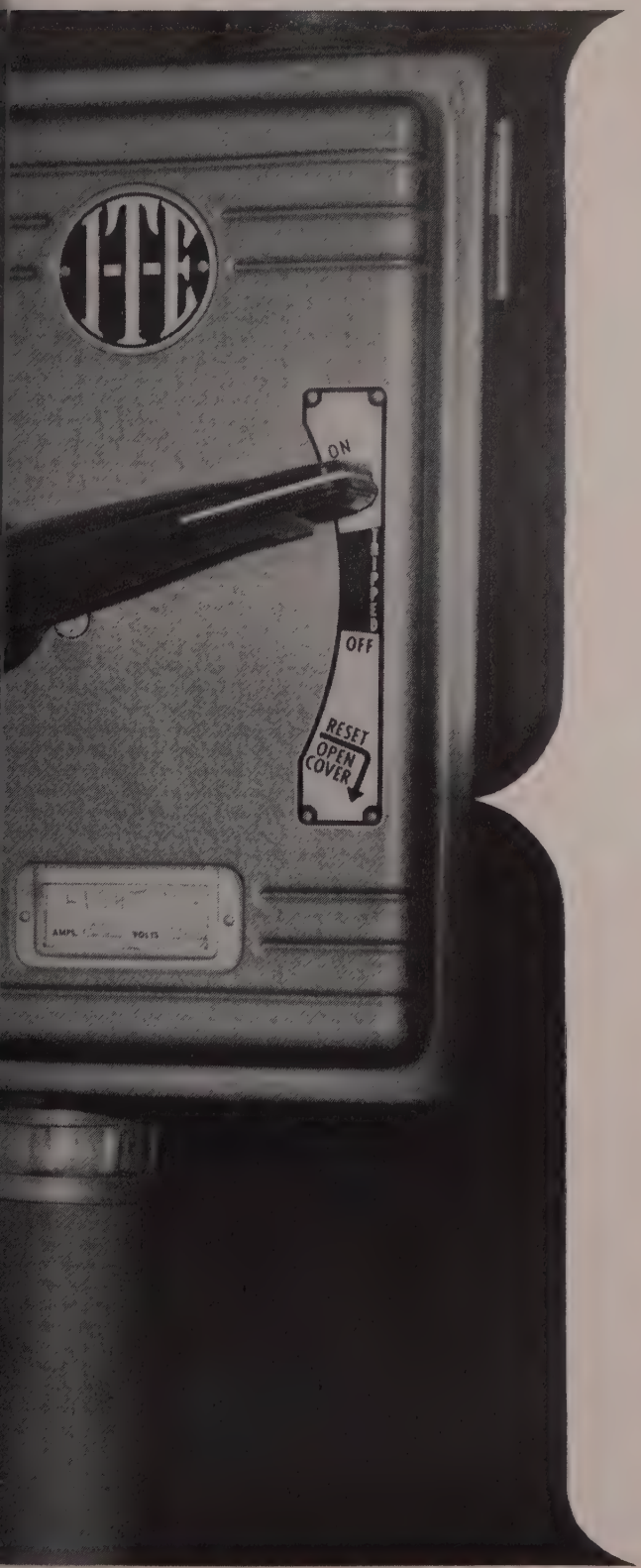
Distributed by GraybaR

"Nobody was going to pin an



TOP QUALITY PRODUCTS . . .
Distributed by Graybar

'old-fashioned' label on me"



"Funny how easy it is to get behind the times. Like I was before I learned about circuit breakers. But nobody can say I'm not up-to-date now.

"All of a sudden, I began noticing the modern, enclosed circuit breakers in use by other plants . . . for machines, lights and production area outlets. Really up-to-date plants use them for practically everything. And engineers tell me they won't take anything else.

"Well, I decided to find out why. And today I use circuit breakers exclusively. What a difference. If we have an overload, we get power back in minutes . . . without idling people and losing production. And my job is easier and a lot safer.

"Cost? Shucks, a circuit breaker saves a whole lot more in production time than it costs new. Today there's darn little excuse for anybody not to use them.

"Here's something else I learned. The guys who really know circuit breakers use I-T-E over any other brand."

Send for the new free bulletin on how circuit breakers benefit industrial plants. Or see your distributor. Write I-T-E Circuit Breaker Company, Dept. SA, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

Chem Marine

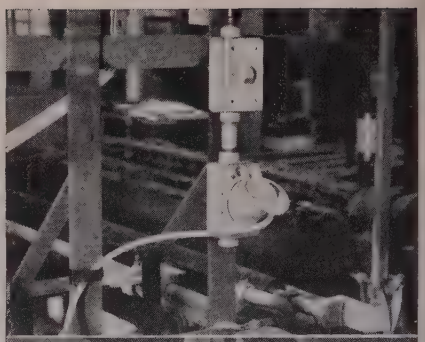
TRADEMARK

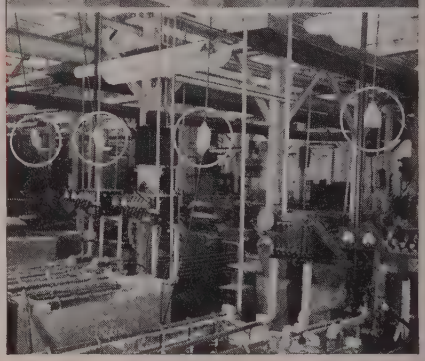
IT PAYS TO HAVE GOOD CONNECTIONS

HUBBELL

REG. U.S. PAT. OFF.

a complete new line of exceptionally rugged wiring devices that withstand adverse conditions





RESISTS CORROSION

This new super line of "Chem Marine" devices are engineered from corrosion resistant materials capable of withstanding the harmful effects of moisture, brine, grease, oils and many acids. They are designed for industrial applications such as plating rooms, shipping platforms, yards, shops, warehouses, or wherever corrosion or chemical action is a problem.

Special Materials:

"INSULPRENE"—a Du Pont neoprene compound.

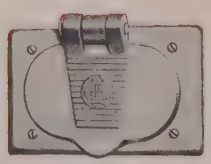
"MONEL® METAL"—Reg. Trademark of INCO.

"MELAMINE"

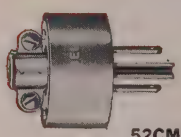
"CYMEL®"—Reg. Trademark of Am. Cyanamid

HEAVY NICKEL-PLATED CURRENT CARRYING PARTS.

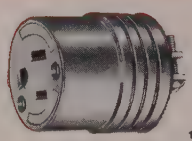
52CM62
3-Wire, 15 amp., 125 volts
Melamine Duplex Grounding Receptacle



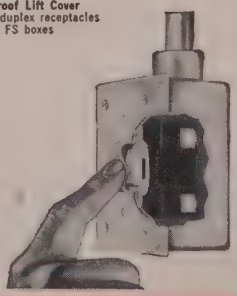
52CM11
Weatherproof Lift Cover Plate for duplex receptacles used with FS boxes



52CM67
3-Wire, 15 amp., 125 volts
"Insulprene" Grounding Cap



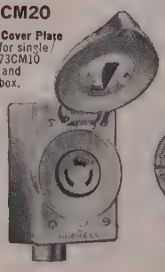
52CM07
3-Wire, 15 amp., 125 volts
"Insulprene" Grounding Connector Body



17CM51
Weatherproof "Insulprene" Plate and A.C. **"Presswitch"** Combination.

Listed by: Underwriters' Laboratories, Inc.

74CM20
Metal Weatherproof Lift Cover Plate with heavy vinyl coating for single receptacles. Shown with 73CM10 "Twist-Lock" Receptacle and mounted to standard FS box.



99CM60
"Twist-Lock" Cap shown with **"Insulprene" "Seal-Tite" Cover 75CM31**

"Chem Marine" devices are identified by their bright yellow color and a few representative items are illustrated above. "Chem Marine" is supplied in a wide variety of "Twist-Lock" and grounding devices to fit any industrial or marine application.

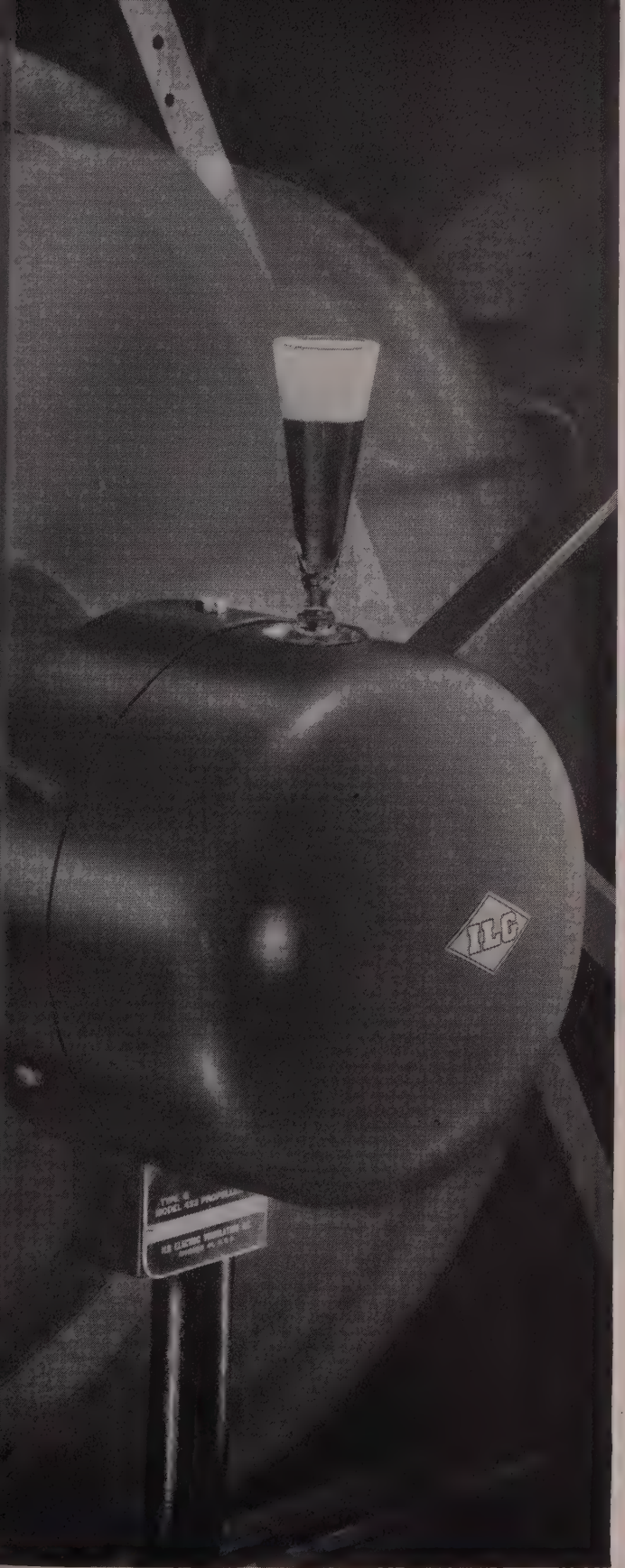
"Chem Marine" units are sold exclusively through authorized Hubbell distributors. For complete information write the "Chem Marine" Department of Harvey Hubbell, Incorporated.

HARVEY HUBBELL, INCORPORATED

BRIDGEPORT 2, CONNECTICUT *The finest in rugged wiring devices since* 1888.

TOP QUALITY PRODUCTS . . .

Distributed by Graybar

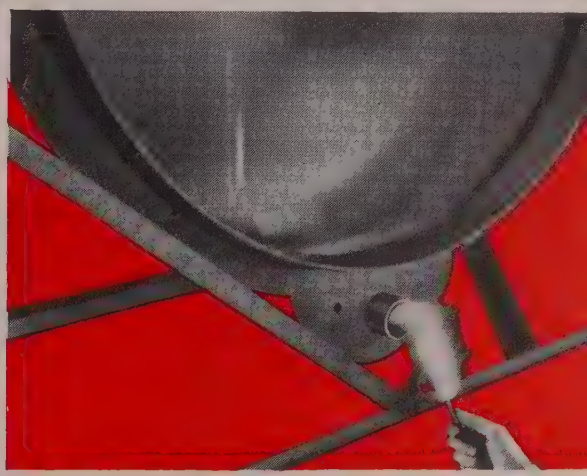


VIBRATION-FREE
as a fan can be

Put a Pilsner on any Ilg propeller fan (as we did on this 42″ model), flip the switch so the fan runs at full speed, and we defy you to find any bubbles in the beer due to vibration.

It runs so smoothly!

At Ilg, careful dynamic balancing of all component parts, and electronic checks of motor and wheels—both before and after assembly — guarantee that smooth and silent operation is as much a part of every propeller fan as the "One-Name-Plate" pledge of performance. And at Ilg that means every fan will last through the years—*without expensive maintenance!*



Follow the Flame and see why Ilg direct-connected propeller fans always run cool. In this unretouched photo, you can see how the vent pipe sucks in outside air to *pressure-cool* permanently lubricated Ilg-built motors, both the single-phase permanent-split capacitor and 3-phase types. Ilg gives you cost operating advantages of *open-type* motors with the protection of *totally enclosed* types. No motor lasts longer.

ILG ELECTRIC VENTILATING CO.

2879 N. Pulaski Road, Chicago 41, Illinois

Offices in more than 57 principal cities

Member of Air Moving and Conditioning Association Inc. (AMCA)

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more use these . . .
IDEAL
TOP QUALITY PRODUCTS
Distributed by GrayBar

than any other.

WIRE-NUTS®

Did you know that every day more electricians make their wire splices with Ideal Wire-Nuts than with all other connectors combined? It's true! There are actually *billions* of Ideal Wire-Nuts giving safe, sure service today. Since its introduction in 1928 as the first successful screw-on connector, Wire-Nut has been the unquestioned leader. Through the years important design and material changes have been made to meet the advancing techniques and requirements of the electrical industry. Today, Wire-Nut has an unmatched record of proven performance, and is recognized by electricians and contractors everywhere as the lowest-cost and easiest method for all common branch circuit and fixture connections. Remember, there is no way known to make a stronger, more permanent wire joint!

For the tools and supplies you need on every wiring job, get the finest

MADE BY IDEAL

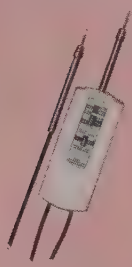
NEW—FOR ALUMINUM CONDUIT

"FLEXI-STRAND", Ideal's new extra-flexible fish tape answers the problems of pulling wires through aluminum. It is made of high quality preformed galvanized aircraft cable. It is more durable, and stronger, and will far out-last ordinary flat tapes. So flexible it will easily take sharp bends in aluminum without cutting. Takes extreme flexing without kinking or taking a set.

"WIRE-LUBE" FOR EASIER WIRE PULLING

Easily applied by hand or brush to any rubber or plastic-covered wire or cable, as they are being pulled into conduit. Wire-Lube protects insulation against breaks, scrapes and strains. Slides wires around bends and thru tight spots. Dries to a fine lubricating powder that makes it easy to add or remove wires later. Non-corrosive, noncombustible, absolutely harmless to hands and clothes.

SUPER-SAFE VOLTAGE TESTER



Safest, easiest-to-use voltage tester made. Designed for rugged daily use. Case is seamless plastic in Safety Yellow, with no surface metal. Prods have extra-safe no-slip grips and 30" neoprene leads. Test for: VOLTAGE (110 to 550v AC; 110 to 600v DC) FREQUENCY (25 to 60 cycles), AC or DC. Solenoid calibrated voltage indicator functions separately from neon test lamp for super-safety. Available with special current-limiting resistors in each prod.

"E-Z" AUTOMATIC HAND STRIPPER

Strips standard branch circuit, fixture and lamp wire, and all other standard or solid wire. Automatic stop locks jaws open after stripping until wire is removed. Eliminates crushed wire ends. Available with eccentric adjustment on blades to limit cutting depth.

"T-5" LOW COST STRIPPER

A handy addition to every electrician's tool kit. Strips No. 10, 12, 14, 16 and 18 gauge wires quickly, cleanly, easily. Cuts and loops wire. Sturdy, compact, constructed of hardened steel for rugged duty and long service. Comfortable plastic grips for sure handling and safety. Overall size, 6". Flat design fits easily into pocket or tool kit.

+GraybaR QUALITY SINCE 1869
+ REG. U.S. PAT. OFF.

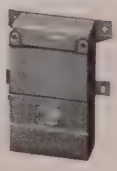
Distributed by
+GraybaR ELECTRIC COMPANY

the HELPING HAND on EVERY WIRING JOB

TOP QUALITY PRODUCTS . . .

Distributed by GraybaR

WALL MOUNTING
50VA—25KVA single-phase
3KVA—15KVA three-phase



CABINET
25KVA—100KVA single-phase
112.5KVA—300KVA three-phase

UNIVERSAL
30KVA—112.5KVA three-phase

In wall, cabinet, or universal mountings, the famous Jefferson Dry-Type transformers are now available through a broader range than ever before. You can now specify Jefferson quality in all the ranges at left—through 600 volts, in both 80°C rise and 150°C rise models. All embody the same Jefferson quality, precision, design and dependable performance you have come to rely on.

Our new catalog gives you the full story of the Jefferson expanded line. And remember—if you have special requirements for transformers, not available in the catalog, our Engineering Department is qualified and equipped to design Jefferson transformers to your specifications. Jefferson field engineers stand ready to assist you in the selection and application of your dry-type transformers.

Write to GRAYBAR for your 1960 catalog

and be sure to ***LOOK FOR THIS SYMBOL OF QUALITY***

on FLUORESCENT ballasts
including the new solid-fill DRI-LOK ballast that cannot drip compound.

on CONTROL transformers
the standard of dependability throughout the industry.

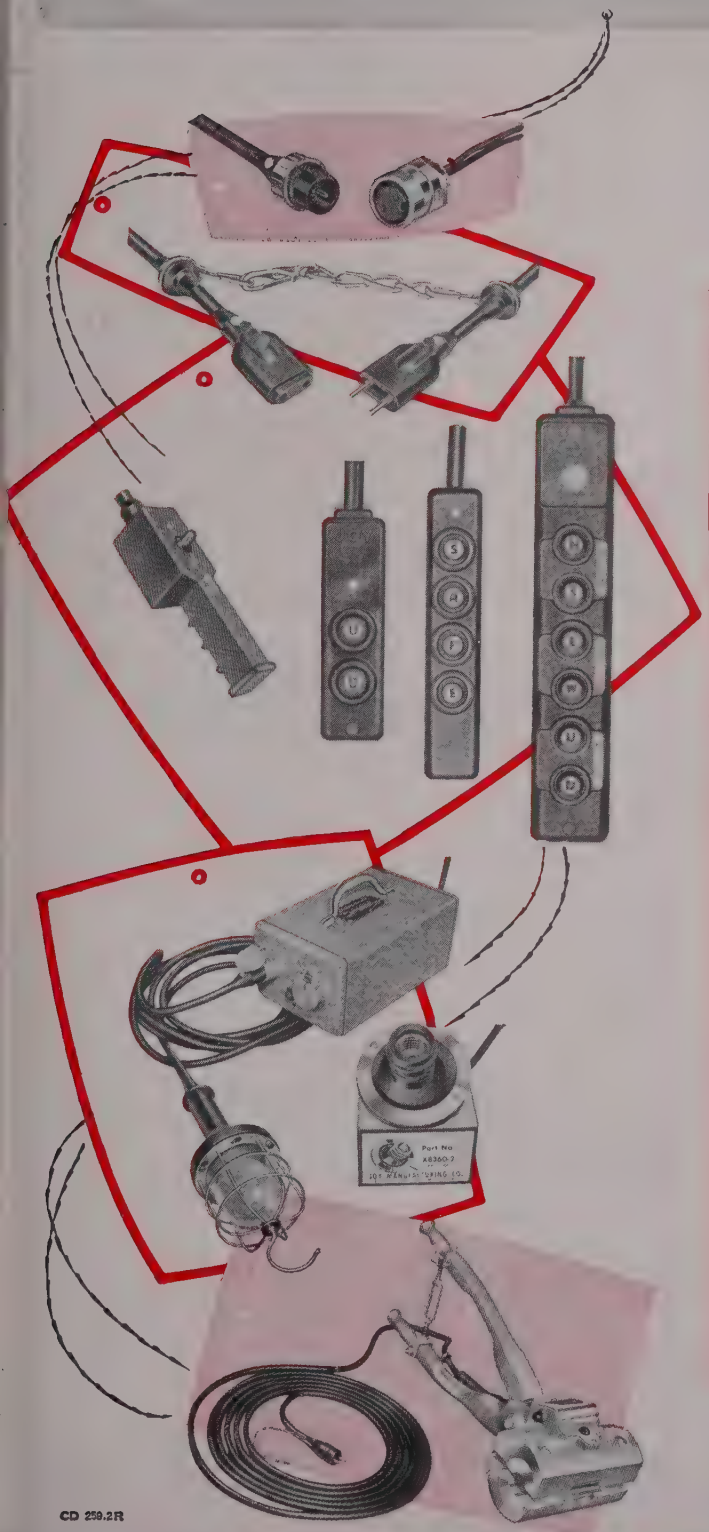
on OUTDOOR MERCURY lamp ballasts
including models featuring Jefferson's exclusive Aqua-Lift sealant.

on INDOOR MERCURY lamp ballasts
a complete line of models for commercial and industrial installation.

Jefferson ELECTRIC COMPANY
Bellwood, Illinois

TOP QUALITY PRODUCTS... Distributed by GRAYBAR

JOY ELECTRIC PRODUCTS FOR YOUR BEST CONNECTIONS



Put quality on the line with Neoprene encased electrical connectors and devices by JOY. Consult your nearby Graybar Man now about JOY safe, durable, and 100% watertight products. Molded-to-cable designs especially suited to provide ultimate in tough moisture-sealed construction.

Send for the Bulletins you need Today!

PRODUCT CLASSIFICATION	GENERAL DESCRIPTION	CAT. NOS.
ELECTRICAL CONNECTORS	JOY "Change-out" Connectors. Mount directly on panels, ducts, outlet boxes, control equipment, etc. Available with 2 thru 4 contacts, up to 20 Amps., 600 V service.	B68
	JOY Type "V" Welding Plugs. Attachable design. Supplied in one size that fits all cable from #4 thru 4/0 A. W. G. Locking engagement with water seal.	F44
	JOY Oval "Push-pull" Connectors for electric lifting magnets. Neoprene molded-to-cable construction. Shatter-proof, moisture-tight and distortion resistant.	B71
ELECTRICAL SWITCHES	9 New Rubber encased Pendent SAFE Switches for electric hoist control. Available in 2, 4, and 6 station models for maintenance free safe operation. Packaged complete, ready to install for 1 and 2 speed, and D. C. control.	B79
	"Pistol Grip" toggle switch handiest for small electric hoist control. Features reversible cable strain relief, and replaceable 250 volt, 15 amp. "UP-DOWN-OFF" toggle switch. Weathertight and hazard free.	B79
LIGHTING EQUIPMENT	JOY "Low Voltage" lighting sets. Choice of 8, 12, or 32 V. with 4 outlets unit rated 400 VA. output. Submersible handlamp assemblies on extension cords supplied with special globes to resist thermal shock.	F45
	JOY "Shatter-proof" bulb sockets. Mount directly on standard 4" outlet boxes. Dampen vibration, prolong filament life.	B71
VULCANIZING PRESSES	JOY "Portable" and "All-Purpose" (bench type) direct heat cable vulcanizers for replacing insulation and repairing jacketing on rubber, rubber synthetic and Thermo plastic jacketed cable. Choice of voltages.	B70

CD 259.2R

JOY

JOY MANUFACTURING COMPANY

ELECTRICAL PRODUCTS DIV., 1231 MACKLIND AVE., ST. LOUIS 10, MO.

EXECUTIVE OFFICES — HENRY W. OLIVER BLDG., PITTSBURGH 22, PA.

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

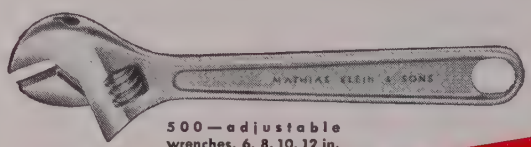
201—famous Klein Side Cutting Plier. Sizes 5, 6, 7, 8 and 9 in.

201-NE—rounded nose side cutting plier. Sizes 5, 6, 7, 8 and 9 in.

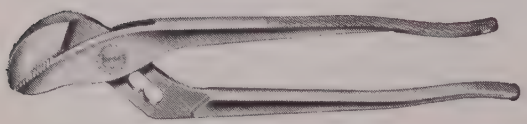
213-9NE—high leverage plier. Will cut regular and weatherproof hard drawn copper wire up to No. 2.

301—long nose plier. Available in 5-, 6- and 7-in. sizes. Also may be had with cutters.

202—narrow nose oblique cutting plier. Available in 5- and 6-in. sizes.



500—adjustable wrenches. 6, 8, 10, 12 in.

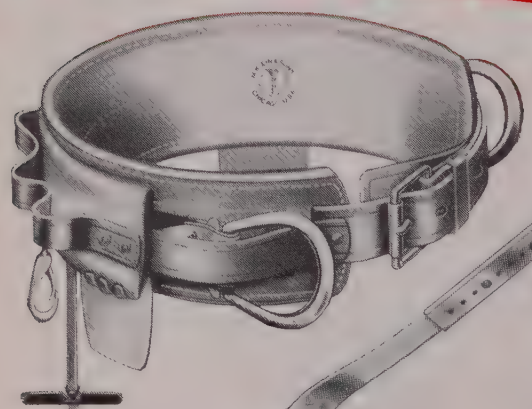


510—pump plier. One hand operation. Length, 9½ in.

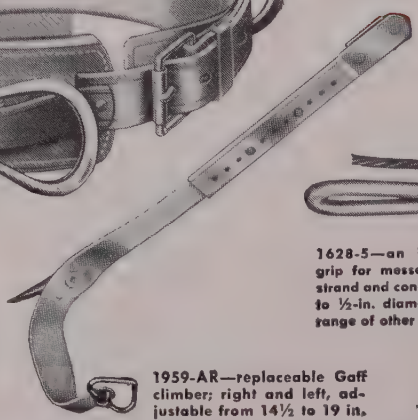
KLEIN TOOLS
EST. 1857

over a century of progress

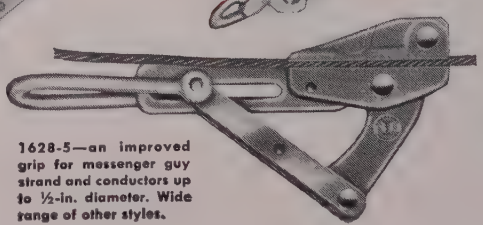
Klein has been the leading supplier of tools and equipment to the electrical industry since the first wires were strung. It was over 100 years ago that Mathias Klein first opened his little forge shop in Chicago. Today the name Klein is known for quality the world over. From your Electrical Distributor, you can secure anything you need in tools and equipment for linemen and electricians. Below are a few of the popular Klein items available.



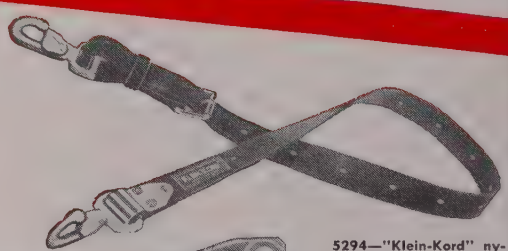
5249—linemen's belt. Full floating with "Klein-Kord" sliding trace. One of a complete line.



1959-AR—replaceable Gaff climber; right and left, adjustable from 14½ to 19 in. Other designs available.



1628-5—an improved grip for messenger guy strand and conductors up to ½-in. diameter. Wide range of other styles.



5294—"Klein-Kord" nylon safety strap made of multiple plies of strong, woven nylon bonded with frictioning and vulcanized in neoprene.

This new Klein Catalog is just off the press. A copy will be sent to anyone interested on request.

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
7200 McCORMICK ROAD • CHICAGO 45, ILLINOIS

TOP QUALITY PRODUCTS . . .

Distributed by Graybar

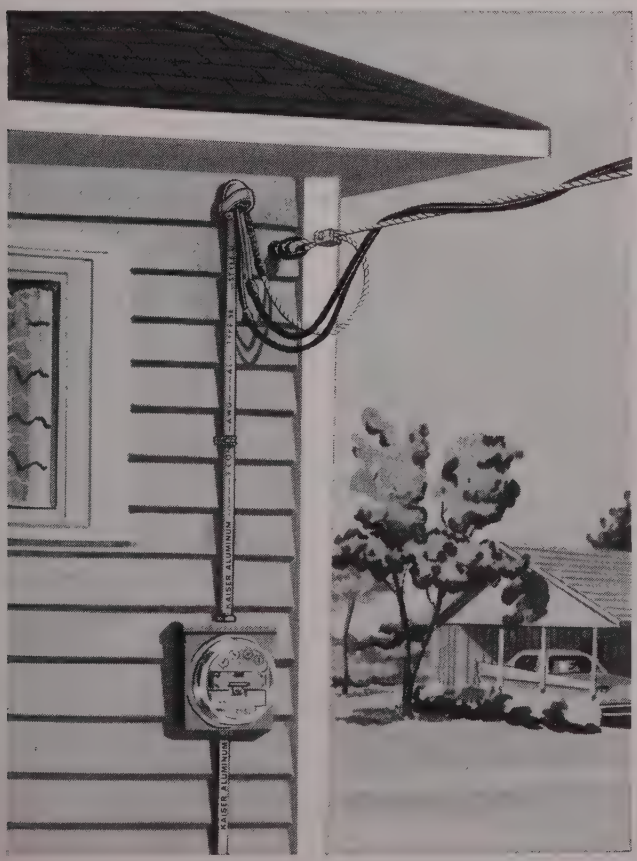
NOW! LOOK HOW MUCH YOU SAVE BY SWITCHING FROM COPPER TO ALUMINUM SE-U!

COST COMPARISON—ALUMINUM VS. COPPER

Service Entrance Cable
Concentric Uninsulated Full Neutral, Braid Jacketed
Underwriters' Type SE, Style U, 75° C. Operation

SERVICE		ALUMINUM		COPPER		SAVINGS WITH ALUMINUM	
Amperes	Feet	Conductor Size AWG	Cable Cost $	Conductor Size AWG	Cable Cost $	$	%
100	20	2	6.88	3	10.64	3.76	35
.....	40	2	13.76	3	21.28	7.52	35
.....	60	2	20.64	3	31.92	11.28	35
150	20	2/0	11.82	1/0	29.50	17.68	60

NOTE: Based on prices in effect as of September 1, 1959.



Check the table . . . at today's prices, braided aluminum SE-U saves you money over copper right down the line!

Note that the cost of #2 aluminum SE-U is 35% *lower* than #3 copper SE-U. With the trend toward larger sizes, savings with aluminum become even greater—up to 60% for 150 ampere service! Neoprene jacketed aluminum cables offer similar savings.

FREE BROCHURE GIVES YOU THE FACTS

Our free brochure, *"KW Service Entrance Cable,"* points out the distinctive characteristics of both braided and neoprene jacketed aluminum cable, and fully explains why this cable offers definite advantages over copper.

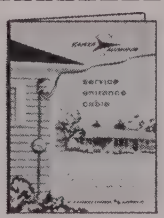
It also describes and illustrates applications of SE-U Cable, as well as Single Conductor in Conduit, and contains a list of manufacturers of accessories for both applications.

Get your free copy of this informative 8-page brochure now. Mail the coupon!

KAISER ALUMINUM*

IF IT CARRIES CURRENT, KW CARRIES IT!

*T. M. Kaiser Aluminum & Chemical Corp.



Kaiser Aluminum & Chemical Sales, Inc.
300 Lakeside Drive, Oakland 12, Calif.

Please send your free brochure, *"KW Service Entrance Cable."*

Name_____

Address_____

City_____ State_____

KAISER ALUMINUM SE-U IS AVAILABLE AT GRAYBAR DISTRIBUTORS

TOP QUALITY PRODUCTS . . . Distributed by Graybar

The most important wiring devices for any installation ...from LEVITON

Flush Tumbler Switches. Over 60 cataloged types are available, including 15 and 20 Amp AC Quiet, 10 and 20 Amp T-Rated AC-DC, and 10 Amp residential switches...backed by Leviton's reputation for superior quality at sensible prices.

LEVITON

Combination Line. Over 30 different cataloged combination duplex devices available. Quiet AC Switches combined with Parallel or U-Ground outlets, Pilot Light, or Duplex Switches in separate or common circuits. AC-DC switches in the same combinations.

LEVITON

Single and Duplex Receptacles. Over 40 different cataloged types. Single and Duplex U-Ground, T-Slotted, Tandem and Parallel, double contact, back and side wired, and Quickwire for heavy duty and residential uses.

LEVITON

Lev·O·Lock Devices. 2, 3, and 4 wire single and duplex receptacles, connectors, caps, and motor plug outlets. Midget 2 and 3 wire caps and cord connectors. For safety, dependability, economy.

. . . when it's important for you to make a choice, you know there's a Leviton wiring device to fit your need. Ask your Leviton Distributor today for your Contractor's ABC. Or write to Leviton Manufacturing Company, Brooklyn 22, New York.

Your best jobs are done with...

LEVITON

Leviton Manufacturing Company, Brooklyn 22, New York • Chicago • Los Angeles • Leviton (Canada) Limited, Montreal
For your wire needs, contact our subsidiary: American Insulated Wire Corporation

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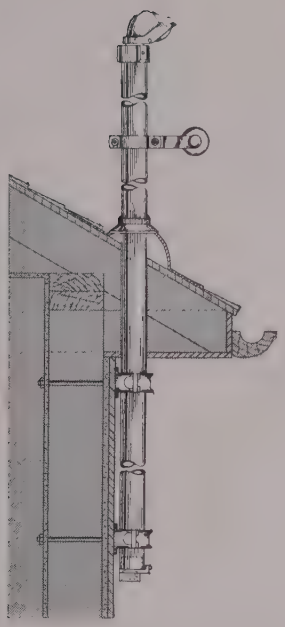
M&W MAST KITS



speed service entrance jobs

- Meet rigid utilities specifications for durability and reliability.
- Fittings are listed by U.L. and C.S.A.
- Use of kits simplifies handling, ordering and storage.
- Mast fittings are also available as individual units.
- Complete line of kits available for 1¼ — 1½ — 2 and 2½" conduit.

M&W ENTRANCE FITTINGS

for 100–150–200 amp cable installations

Service entrance heads, straps, watertight and non-watertight connectors and sill plates are available in kit form, or as separate units. Complete line of fittings available for cable sizes of 3 no. 3 through 3 no. 4/0 entrance cable.

For details and prices, send for your copy of the latest M&W Catalog, containing a complete line of electrical fittings for every purpose.

THE M. & W. ELECTRIC MFG. CO., INC.

EAST PALESTINE, OHIO

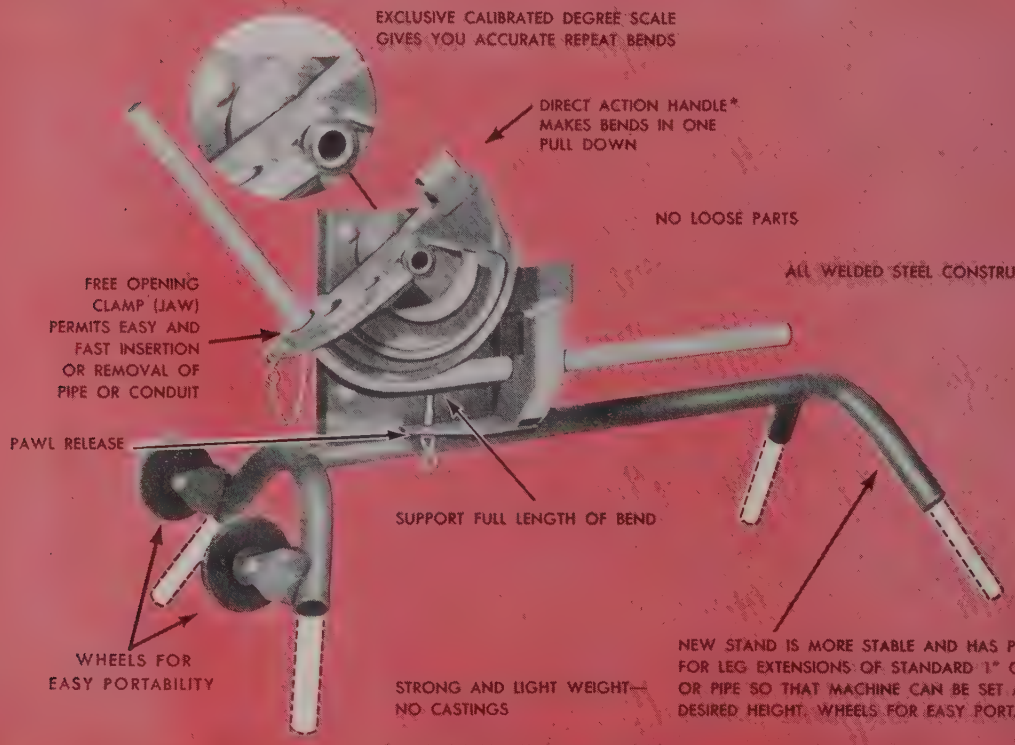
TOP QUALITY PRODUCTS . . . Distributed by GraybaR

bend conduit or pipe

EASILY AND ACCURATELY WITH THE IMPROVED

LIDSEEN "CHICAGO" BENDER

MODELS FOR RIGID OR THINWALL . . . STEEL OR ALUMINUM



*on Models No. 5100 and No. 5300

No. 5100	Rigid or Pipe
No. 5300	Thinwall

No. 5200	Rigid or Pipe
No. 5400	Thinwall

BENDS ½", ¾" and 1" CONDUIT EASILY WITHOUT CHANGING PARTS Lidseen "Chicago" Benders have always been the most portable on the market. Now, by careful design and the use of strong welded steel construction, strength is built in where needed and not elsewhere, as is often necessary with castings. This method of construction has further reduced weight 14% to 30%. This weight reduction, coupled with the new wheeled stand makes *real* portability! No. 5100 bends ½" rigid conduit or pipe to an inside radius of 2"; ¾" to 4¼" radius and 1" to 5¾" radius without changing parts. No. 5300 for thinwall bends ½" EMT to an inside radius of 4"; ¾" EMT to 5" radius and 1" EMT to 6" radius, also without changing parts.

FOR LARGER SIZES . . . BENDS 1¼" and 1½" CONDUIT WITH EASE Redesigned for weight reduction and greater portability, the new Lidseen "Chicago" bender has a wheeled stand that enables the electrician to keep the bender on the job in a perfect working position without hauling dead weight around. Without changing parts, No. 5200 bends 1¼" rigid conduit or pipe to a radius of 7¼", and 1½" rigid to 8¾" radius. . . No. 5400 bends 1¼" thinwall to 8" radius and 1½" thinwall to 10" radius. Its rugged ratchet mechanism eliminates strain . . . makes the bend easy.

For full details
write for **BULLETIN NO. 260**

LIDSEEN OF NORTH CAROLINA, INC.

2005 FIRST STREET • HAYESVILLE, NORTH CAROLINA

TOP QUALITY PRODUCTS . . . Distributed by Graybar

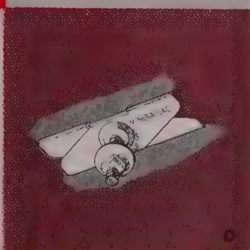
WHY GUESS?

BE SURE WITH "SIZE-MARKED" MINERALLAC METAL FITTINGS!

A

B

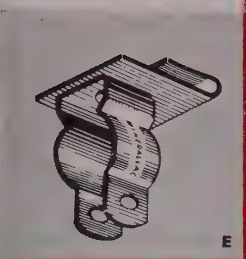
C



D

End time-consuming guesswork and costly mismatches in the stockroom and on the job with MINERALLAC Fittings with exclusive "Size-Marked" feature! Each MINERALLAC Hanger, Clip, Strap and Beam Clamp is clearly and individually stamped with its *exact size* for immediate identification and quick, easy handling. Where time is money, "Size-Marked" Metal Fittings help you save!

You'll enjoy a triple advantage when you specify MINERALLAC. Exclusive, "Size-Marked" time saving *Economy* . . . plus outstanding Service and fast *Delivery* which have made MINERALLAC famous with leading contractors throughout the world.



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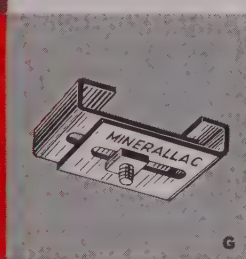

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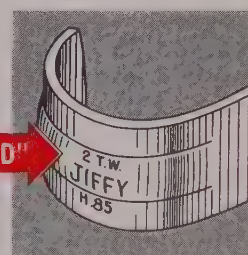
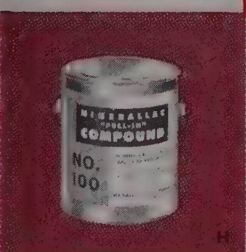
WHEN IT'S "SIZE-MARKED" YOU CAN BE SURE!





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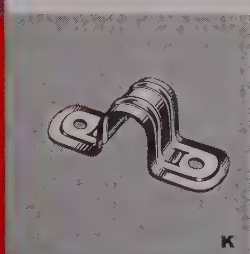

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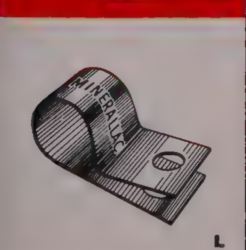


L

SEND FOR LITERATURE AND PRICES...

A. Hangers—Cable and Conduit Hangers. In Zinc-plated Steel and Everdur. All sizes. Insulated bushings available. Top quality. Permit quick wiring.

B. Steel Beam Clamps—for Mounting Hangers on I Beams. Mounts Minerallac hangers No. 0 to No. 6 on I-Beams without necessity of drilling holes. Have ¼-20 tapped holes. Fits beam flanges up to ½" thick. Low cost.

C. Heavy Duty and Medium Jiffy Clips—Made of heavier material. Has exclusive inverted rib, that provides more strength at the bend of clip . . . and, of course, adds the benefits of famous "Snap On" feature!

D. Scissor Clip—Two-piece clip for mounting Fixtures, Boxes or Conduit Hangers to 1-inch T-Bar. Easy to install and locks in place.

E. Min-A-Clip—The most efficient and economical method available for installing Conduit or Pipe on Bulb Tee Irons of "Poured Gypsum Deck Type Roofs". Hanger turns on rivet, eliminating many bends.

F. Stud Clip and Fixture Stud Clip—For mounting 8B or 1900 Outlet Boxes or hanging Fixtures on Bulb Tee Irons. Fixture Clip available for either pipe or rod.

G. Two-Piece Stud Clip—For mounting Fixtures, Boxes or Conduit Hangers to Tee Irons on Beams heavier than 1-inch T-Bar. Fits flanges 1⅝" to 2⅝" width, up to ¼" thick.

H. No. 100 "Pull-In" Compound—For Rubber, Synthetic, Plastic or Lead-Covered Wires or Cables. Approved by Underwriters' Laboratories for lubricating wires and cables to facilitate pulling them into conduits. Not injurious to wire or covers. Available in pint, quart, ½-gallon, gallon and 5-gallon cans.

I. Insulating Compounds—A dependable line of insulating compounds for use in Cable Joints, Potheads and Terminal Bells. Eight types for various voltage, temperature and climatic conditions. Also Oil Insoluble Compounds. Available in ½-gallon, 1-gallon, 2-gallon, 5-gallon and 50-gallon drums.

J. Ring Hangers—For supporting cable, conduit or pipe. Stocked in sizes from ½" to 2". Can be used in combination with Minerallac Perforated Strap. Zinc-Plated Steel. Special sizes available on request.

K. Two-Hole Pipe Straps—For cable, conduit and pipe. Available in Zinc-Plated Steel or Everdur for sizes from ½" T. W. to 1" I.P. Available in Zinc-Plated Steel only for sizes from 1¼" T. W. to 6" I. P.

L. Closed Clips—For supporting tubing, pipe, etc., in sizes from ¼" O. D. to 1" O. D. Available in Zinc-Plated Steel or Everdur Alloy.

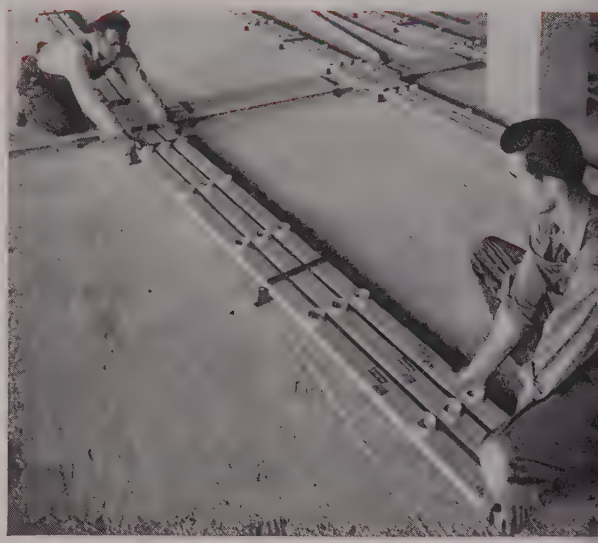
MINERALLAC® Electric COMPANY
ESTABLISHED 1894
25 NORTH PEORIA STREET • • CHICAGO 7, ILLINOIS

TOP QUALITY PRODUCTS...

Distributed by GraybaR

Here's what top electrical contractors say about easily-installed SPANG raceways:

M. B. FOSTER ELECTRICAL COMPANY, BOSTON. General Superintendent Vern Santas reports, "This combination of *SPANG Headerduct* and cellular flooring is the most progressive step in electrical distribution in 25 years. Our men shown here on the National Life Building job work in teams for fast, accurate installations." SPANG representative trained installation crew on the job.



PATTERSON-EMERSON-COMSTOCK, INC., SAN FRANCISCO. According to Job Superintendent Reave A. Tague, "The *SPANG Underfloor Duct* system we installed in the San Francisco State Office Building meets all today's needs . . . and provides for inexpensive future expansion. We prefer SPANG Underfloor Duct, because the number of component parts are few, and all fit together easily."

J. LIVINGSTON AND COMPANY, DETROIT. John C. Gnass, Job Superintendent, states, "We estimated a savings of 25% installation time using *SPANG Headerduct* in the new main office of the National Bank of Detroit. Two exclusive features of the SPANG junction box made this possible: corner leveling screws for fast, easy adjustment; and square openings for more working area."

WALTER J. BARNES ELECTRICAL COMPANY, NEW ORLEANS. Walter J. Barnes, Proprietor, says, "*SPANG Underfloor Duct* offers ease of handling and installation. For Moisant International Airport extension we installed SPANG Underfloor Duct to handle the power and telephone wiring. Particularly we liked the carefully-designed junction boxes, which eliminated installation errors."

You, too, can have flexible, modern electrical installations . . . with either SPANG Headerduct or Underfloor Duct. For complete details on design and installation procedures, call your local SPANG Representative, or write to the National Supply Company, Two Gateway Center, Pittsburgh 30, Pennsylvania.

SPANG UNDERFLOOR DUCT

THE NATIONAL SUPPLY COMPANY

Subsidiary of Armco Steel Corporation

TWO GATEWAY CENTER, PITTSBURGH, PA.

TOP QUALITY PRODUCTS . . . Distributed by Graybar

HERE ARE 11 GOOD REASONS WHY SPANG STEEL CONDUIT IS YOUR BEST BUY

1. **High strength** . . . SPANG Conduit resists crushing and mechanical injury from rough treatment at job site better than other types of raceways.

2. **Uniform throughout** . . . bends easily . . . no hard or soft spots . . . quickly and accurately threaded . . . saves installation time.

3. **Smooth interior finish** . . . uniform hard surfaces for easy, trouble-free wire pulling. No obstructions, no burrs to damage wires.

4. **Exceptional corrosion resistance** . . . hot-dipped, heavy-duty galvanized finish and lacquer coating are highly resistant to moisture, cracking, peeling or flaking. No special coating needed for embedding in concrete.

5. **Clean threads** . . . uniform, no burrs. Specially-prepared coating helps prevent rust formation.

6. **Vibration resistant** . . . combination rigid steel conduit, threaded couplings and fittings is inherently strong and vibration resistant.

7. **Excellent electrical characteristics** . . . greater conductivity than needed under worst grounding conditions. High resistance to arcing, short circuiting. Unaffected by contact with dissimilar metals.

8. **Tested and inspected** . . . Preece Test and bending test applied to samples from each lot. Each length inspected for uniformity and straightness.

9. **Color coded for size identification** . . . colored thread protectors on each length of conduit save you time in inventory, at job site.

10. **Bundled with steel strapping** . . . in sizes ½" through 1½" for added safety and convenience in handling, transporting, storage.

11. **Approved** . . . by Underwriters' Laboratory, Inc. Meets all Federal and ASA specifications.

That's the story on SPANG Steel Conduit. But best way to prove that SPANG is your best conduit buy is to try it on your next installation. Your local SPANG Distributor will be glad to serve you. Give him a call!

SPANG® CONDUIT

THE NATIONAL SUPPLY COMPANY

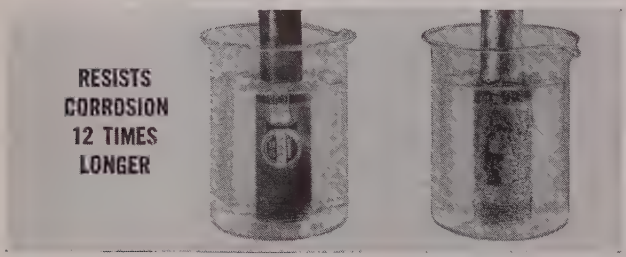
Subsidiary of Armco Steel Corporation

TWO GATEWAY CENTER, PITTSBURGH, PA.

TOP QUALITY PRODUCTS . . . Distributed by Graybar

NATIONAL ELECTRIC DIVISION

NEW! BETTER! BEST! FROM NATIONAL ELECTRIC!

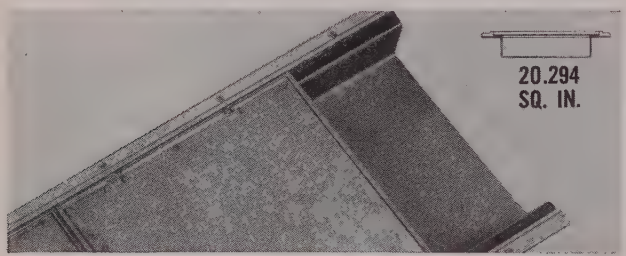


SHERARDUCT RIGID CONDUIT

Acid bath torture test proves superiority. Double protection: It's Sherardized (exclusive zinc process to galvanize in *depth*)! It's coated inside and out with MVC-1 (exclusive polyvinyl chloride resin that lasts and lasts)!

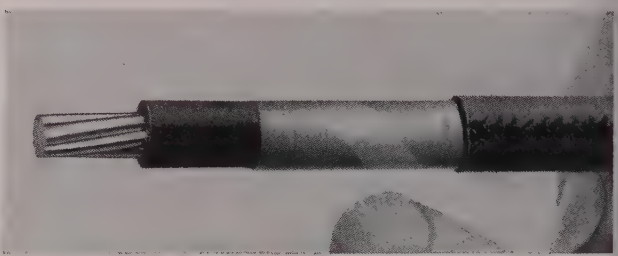
XDUCT JUNIOR

Quality control eliminates splits and high seams. E.M.T. with automated electronically-inspected production. Electrogalvanized outside surface. Easy fishing. Superior bending. Silvery color.



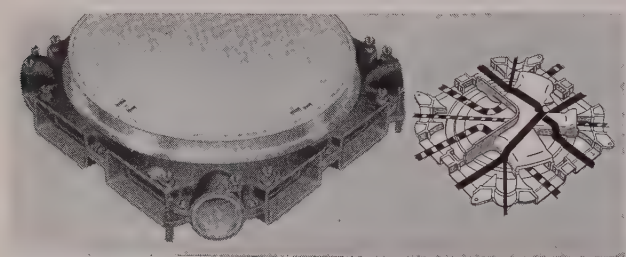
NEW! 15,000 SERIES HEADERDUCT

Largest available capacity. A full 20.294 square inches of wiring area. Provides 100% accessibility to any or all cells in cellular steel floors. Handles largest phone cables. A complete system for cellular floor construction.



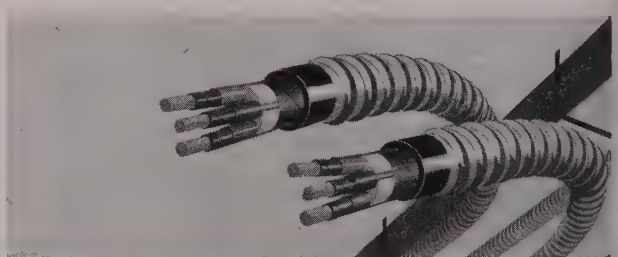
MYLAR* TAPED BUILDING WIRE

Four times the abrasion resistance of rubber-filled tape. Highly resistant to flexing. High dielectric strength. Withstands action of acids, alkalies, moisture, and oxidation. Smaller diameter. *Dupont "Mylar".



NEPCODUCT

New junction box is quickly brought into alignment with finished floor even after concrete has set. Leveling adjustment can be made with screwdriver without removing cover plate. Lazy susan interior partition can be relocated in case box should be inadvertently installed in incorrect position.



NEPCO-LOK INTERLOCKED ARMORED CABLE

Outstanding flexibility cuts installation costs. Installed quickly around corners and projections. Economically relocated for changing power needs of the future. 600-5,000 or 15,000 volt . . . one, two, three, four conductor and control cable assemblies.

NATIONAL ELECTRIC DIVISION PORTER **H.K. PORTER COMPANY, INC.**

PORTER SERVES INDUSTRY with steel, rubber and friction products, asbestos textiles, high voltage electrical equipment, electrical wire and cable, wiring systems, motors, fans, blowers, specialty alloys, paints, refractories, tools, forgings and pipe fittings, roll formings and stampings, wire rope and strand.

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

EFFICIENCY IS HIGH WHEN THE TOOL IS A

"The Tools You Swear By... Never At!"

NYE

51-B RATCHET PIPE THREADER

SIZES 1"-2"

PATENTED FEATURES

- JAM PROOF
- AUTOMATIC "kick-out" hand or power
- MANUAL "kick-out" for short threads

Easiest and fastest pipe threader on the market today. Get a demonstration and you will see why NYE is the best.

COMBINATION VISE STANDS

Base designed so yoke vise parts (⅛" to 2½") can be replaced by chain vise parts (½" to 4"), or vice versa.

● SEE YOUR JOBBER

NEW HEAVY DUTY SELF LOCKING VISES

Long Jaw Vises . . . a NYE origination. All yoke type vises have a pipe rest and benders on base. Sizes ⅛" to 4½".

● SEE YOUR JOBBER

"FOUR POINT" BALL BEARING KNOCKOUT PUNCHES

HAND or HYDRAULIC

Cuts clean burrless holes, fast. Coarse thread on screw drive (12) against (24) lessens cutting operation by 50%.

● SEE YOUR JOBBER

TRIPLEX SOLID DIE STOCK

Excellent for hand or power threading. Supplied in two combinations: ⅜" to ¾" and ½" to 1".

● SEE YOUR JOBBER

FOR PIPE OR CONDUIT DIES

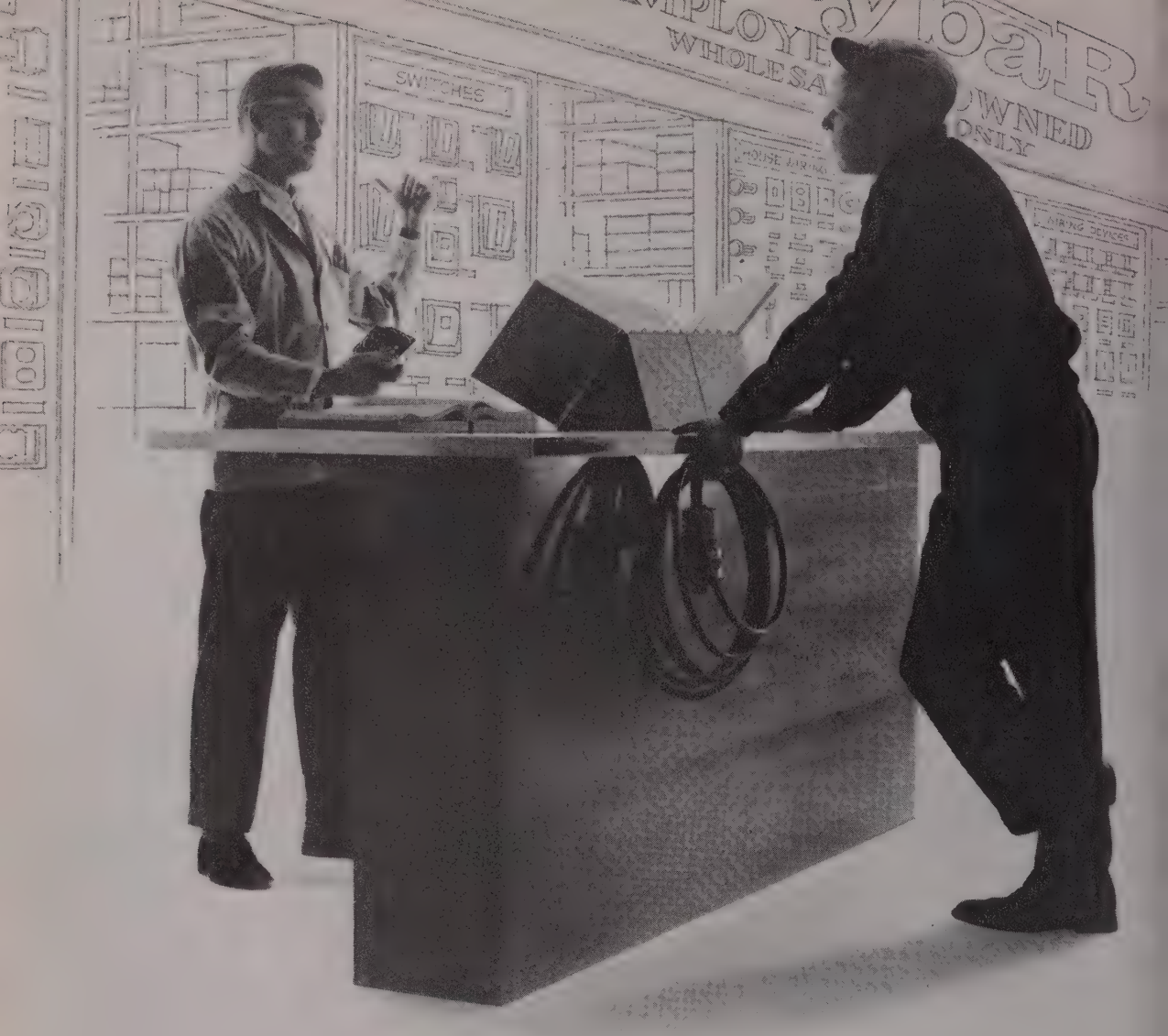
NYE TRIAD STOCK #50

Can be furnished for Conduit or Pipe Threads ⅛" to ¾" and ⅛" to 1¼". Exclusive with NYE, the SKIP TOOTH die.

● SEE YOUR JOBBER

NYE TOOL COMPANY 4122 Fullerton Avenue, Chicago 39, Illinois

TOP QUALITY PRODUCTS . . . Distributed by Graybar



"If you need it, we have it!"

Walk in to any Graybar counter and you'll find the lines complete. That's mighty important when you want to move fast, or meet tough specs.

You'll also find the wide range of electrical items that makes it practical to buy from one source . . . motors, controls, conduit, fittings, everything from the newest in lighting fixtures to the wiring materials you need for the bread and butter jobs. There's real technical help. Orders are assembled fast. There's even a phone handy — for your use.

Moreover, the Graybar Counterman is but one of several well trained men on the Graybar electrical contractor service team. The others are: Inside Salesman, Field Salesman, Specialists. The job of all of them: to *reduce your costs, speed your work,* help *build your business.*

Isn't it about time you tried Graybar? Call us. See how fast we move for *you.* 917

Graybar Service includes: Objective recommendations. On-the-job technical help. Most complete lines. Planned stocks to meet your needs. Expert counter service. Speedy handling of will-calls.

GraybaR

ELECTRIC COMPANY, INC.

420 LEXINGTON AVENUE, NEW YORK 17, N. Y. • OFFICES IN OVER 130 PRINCIPAL CITIES

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

NEW

JOINS 26% FASTER

Because there are no separate couplings to assemble on the job, Orangeburg's new CA Conduit lays faster—costs less to install. In addition, there are no coupling cartons to handle, transport or store.

Orangeburg's new CA Conduit comes, at *no extra cost,* with a factory-attached coupling at one end and a standard 2° male taper at the other end. To join—CA's long, lightweight lengths are placed end to end—hammered home in a simple, one-step operation. Actual installations *prove* Orangeburg's new CA Conduit joins up to 26% faster!

What's more, because the attached coupling is *flush* with the outside diameter of the conduit, new CA Conduit is easy to handle and store in neat, even stacks. And with the new flush coupling there's no need to "stagger" conduit joints in the trench. That means less cutting and tooling time.

New CA Conduit—like the millions of feet of Orangeburg Fibre Conduit in use since 1893—has self-sealing joints and impermeable walls that make it absolutely watertight. Its smooth 100% fibre raceway adds years to cable life.

Specify new CA Conduit on your next job. This addition to Orangeburg's line is available in 2", 3", 3½", 4", 4½" and 5" sizes. Orangeburg's Standard and Nocrete Conduit with separate sleeve couplings are available as always. Orangeburg Manufacturing Co., Orangeburg, N. Y.

ORANGEBURG MANUFACTURING CO.
Division of The Flintkote Company, Manufacturer of America's Broadest Line of Building Products

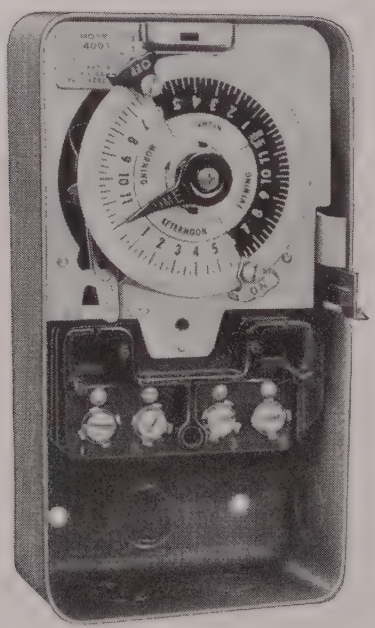
FLINTKOTE

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

brand new...and T-rific!

PARAGON'S 4000 SERIES TIME SWITCH...

40 AMPERE T-RATED



33⅓% GREATER SAFETY FACTOR — Thanks to new 40 ampere tungsten design.

ENDS COSTLY CALL-BACKS — Wiping contacts, no welding, self-cleaning, high conductivity.

LONGER LIFE — Light trip action eliminates strain on motor and gears.

MINIMUM MAINTENANCE — Heavy duty motor and specially lubricated bearings combine for trouble-free, silent, dependable service.

EASY INSTALLATION — Molded terminal block. Heavy unit construction. Large terminal screws. Single pole models equipped with four terminals. No need to force two wires under one screw. Spacious wiring gutter. Easily removable knock-outs in bottom, sides and back.

CHANGEOVERS SIMPLIFIED — Snap-out movement assures fast, easy removal and replacement.

COMPACT STYLING — Case measures only 7¾" high, 4¼" wide, 3" deep.

EASY TO SET, EASY TO READ — Dial riders are simple to add or remove. Heavy 1-way friction. No need to disengage gears when setting. Dial can be revolved through tripping operations for testing switch operation.

HAND-TRIP CHECKOUT—Manual skip-trip provides hand-tripping of switch . . . either ON or OFF ahead of automatic setting without disturbing automatic sequence.

ASTRO DIAL — Enables time switch to operate according to rising and setting of the sun.

SKIP-A-DAY DEVICE — Permits elimination of operations on any day or days of the week.

The 4000 Series is specially designed to avoid problems of contact welding. And with free-floating "make" and "break" contacts, it introduces a new concept in switching mechanisms.

CATALOG 5919 contains complete information on Paragon's new 4000 Series time switch. Write for your copy today!

TIME IS MONEY — CONTROL IT WITH PARAGON

PARAGON ELECTRIC COMPANY

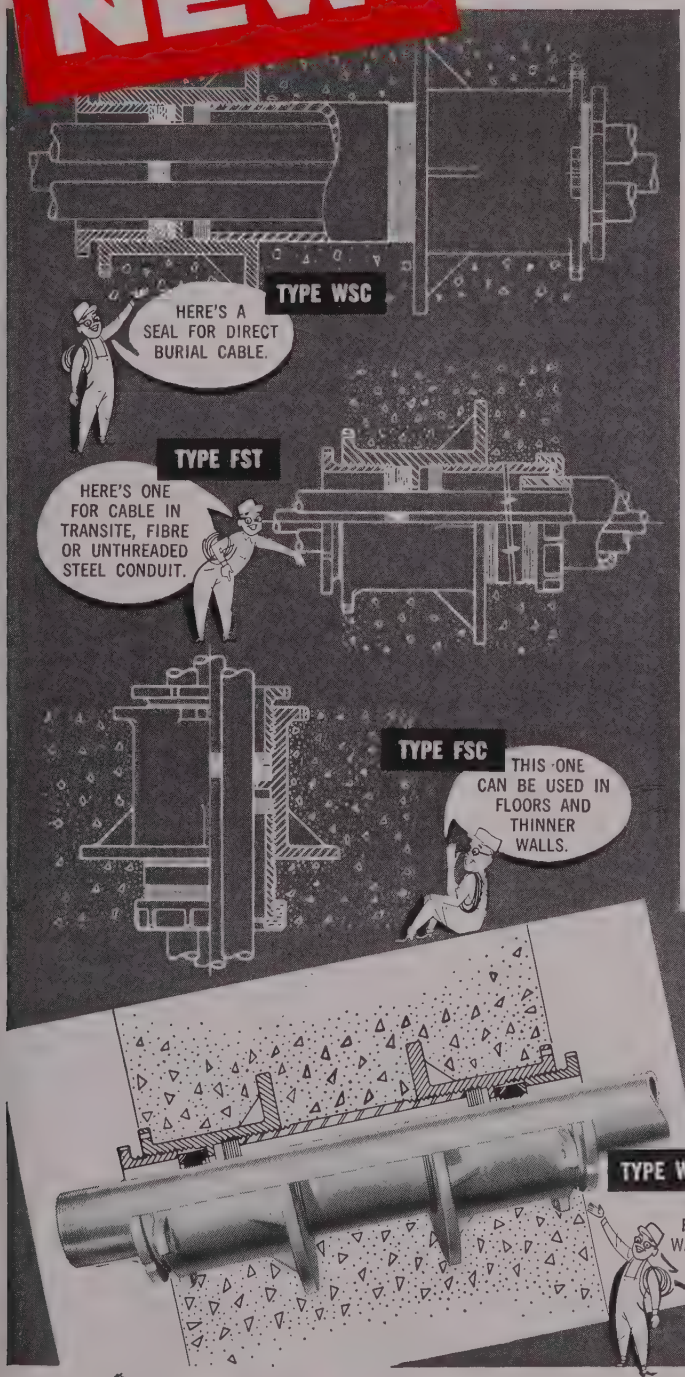
1614 TWELFTH STREET • TWO RIVERS, WISCONSIN

IN CANADA: AUTOMATIC ELECTRIC SALES (Canada) Ltd., Toronto.

Export Dept.: 15 Moore Street, New York 4, N. Y.

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

NEW! a complete line of O.Z. WATERTIGHT ENTRANCE FITTINGS for Conduit or Cable



End leakage problems once and for all! O.Z.'s new wall and floor entrance fittings for installation in concrete provide a positively watertight seal around conduit or cable at any pass-through point! Use them with threaded or unthreaded steel conduit, fibre or Transite® conduit, or exposed cables of varying number and sizes. Gland-type sealing assemblies, with pressure bushings, may be tightened at any time. Fittings accommodate conduit ranging from ¾" to 6". Standard types, sizes available from stock. Specials made to order.

For more information on fittings and other O.Z. products, call your local distributor, or write to the company.

® *Registered trade-mark of Johns-Manville Corp.*

O.Z. ELECTRICAL MANUFACTURING CO., INC.

262 BOND STREET • BROOKLYN 17, N. Y.

- CAST IRON BOXES
- CABLE TERMINATORS
- POWER CONNECTORS
- SOLDERLESS CONNECTORS
- GROUNDING DEVICES
- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS

Sales Office and Warehouse: 406 So Cicero Avenue, Chicago 44, Ill. • ESterbrook 9-0326
Office and Factory: 749 Bryant Street, San Francisco 7, Calif. • GArfield 1-7846

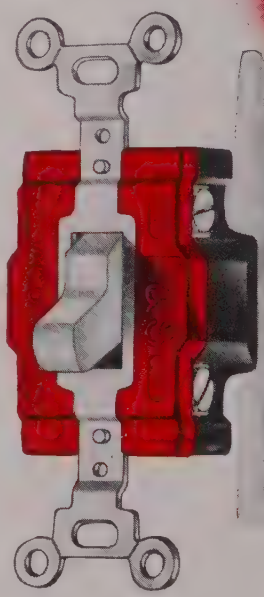
TOP QUALITY PRODUCTS . . . Distributed by Graybar

For Dependability Beyond a Doubt Always Specify P&S

"A quality building for quality tenants*" demands quality wiring devices. That's why the beautiful new Canada House at 680 Fifth Avenue in New York uses P&S 20AC1-I AC switches. A good reason, too, why P&S 5252-I and P&S 7310's are also used.

P&S 20AC1 heavy duty AC switches are designed with extra-heavy silver alloy contacts mounted vertically at the *nodal point* (point of least vibration) to avoid excessive vibration and eliminate arcing and poor contact. P&S super AC switches can be used at full rated capacity for tungsten filament lamp loads and fluorescent installations.

*Slogan for the new Canada House



20AC 1 Ivory

5252-I

7310

For information on these and other P&S wiring devices write Dept. GB-46.

P&S®

PASS & SEYMOUR, INC.

SYRACUSE 9, NEW YORK

60 E. 42nd St., New York 17, N. Y. 1440 N. Pulaski Rd., Chicago 51, Ill. In Canada: Renfrew Electric Co., Ltd., Toronto, Ontario

TOP QUALITY PRODUCTS . . . Distributed by GRAYBAR

New Permacel Junction Box Mount epoxy adhesive

. . . the fast, easy way to attach junction boxes to any surface

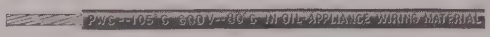
PERMACEL®

NEW BRUNSWICK, NEW JERSEY • TAPES • ELECTRICAL INSULATING MATERIALS • ADHESIVES

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

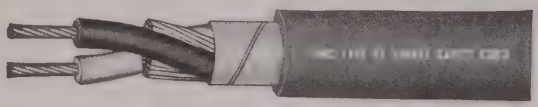
PWC INSULATED WIRES, CABLES AND CORD SETS

BUS DROP CABLE
Flexible and extensible branch circuits for machine shops.

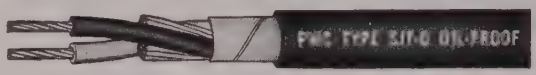


APPLIANCE WIRING MATERIAL
90° and 105°C Underwriters' Laboratories listed.

GASOLINE AND OIL RESISTANT WIRE
UL approved—sizes #14 to 500 MCM.



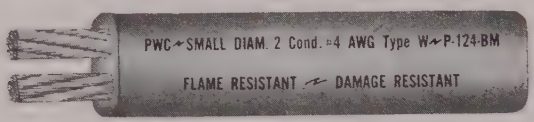
TYPE ST YANKEE SAFETY CORD
UL listed Type ST and SJT in Safety Yellow.



TYPE ST OIL-PROOF
UL listed Oil Proof Type ST and SJT.

STATION CONTROL CABLE
Conforms to IPCEA Standards, column "B" insulation.

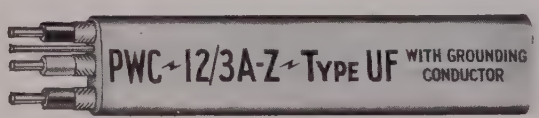
IMSA CONTROL CABLE
Conforms to IMSA Specifications 19 and 20—1956.



PARALLEL POWER AND MINE CABLE
Listed by U. S. and Penna. Bureau of Mines.

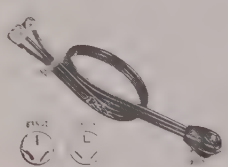
INSIDE TELEPHONE CABLE
Commercial establishments and special plan wiring systems.

TYPE ST FLEXIBLE POWER CABLE
Conforms to IPCEA and U.L. for 600 volt cables.



A-Z TYPE UF
Single conductor No. 14 to No. 4/0 Multiple conductor No. 14 to No. 6.

FLEXIBLE CABLE
Conforms to UL and IPCEA Standard.



RANGE AND DRYER CORD SET
Underwriters' Laboratories listed.

EXTENSION CORD SET
Safety yellow for portable tools, outside lights and power.

For additional information and special construction contact the PWC General Office.

THE PLASTIC WIRE & CABLE CORPORATION

JEWETT CITY, CONNECTICUT

TOP QUALITY PRODUCTS . . . Distributed by Graybar

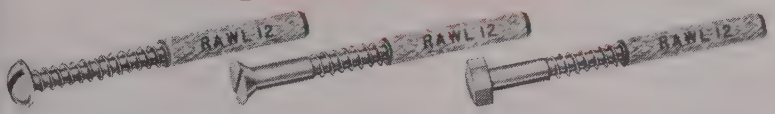
Time-saving, money-saving masonry anchors and drills by

RAWLPLUG

for anchoring conduit, duct, equipment or any other kind of fixture to any kind of masonry

RAWL ANCHORS

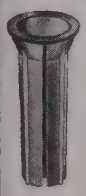
Branded RAWLPLUGS



FOR SHEET METAL SCREWS • STANDARD WOOD SCREWS • LAG SCREWS

The only universal masonry anchors . . . will hold securely in any kind of masonry . . . won't fracture brittle or fragile material. Diameters and lengths for all types of screws, every size from #6 through 5/8".

High holding power lets you use a smaller size Rawlplug, drill a smaller-diameter hole, than with any other type of masonry anchor. Elastic-compression expansion that gives the Rawlplug its holding power also soaks up vibration, prevents creeping or failure.



RAWL SCRU-LEADS

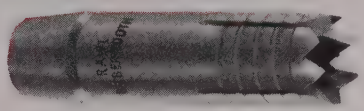
Lead Screw Anchors for sheet metal screws and standard wood screws. The most holding power possible with any lead screw anchor.
Exclusive Rawloy, lead alloy especially developed for masonry anchors, used for ease of installation and sure holding power.
Flange permits use in hollow material.

RAWL LAG-SHIELDS

Lag Screw Expansion Shields

The Rawl Lag Screw Shield is a completely rustproof precision-cast lag shield made of durable alloy.
Ideal for all masonry fastening, especially where problem masonry is encountered.
Horizontal fins prevent shield from turning in hole.
Tapered outside rings have tremendous biting power.

RAWL SABER-TOOTH® Drill-n-Anchor

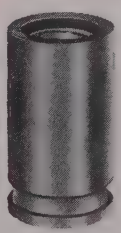


DURATHERM heat-treated to drill fast, hold tight. *Combined drill and anchor saves time and trouble, cuts costs.* Install a Saber-Tooth in only 45 seconds! Core-action drilling cuts only the masonry around the hole's perimeter. You get a sharp, new drill for each installation . . . have no separate drills to buy or sharpen. You don't have to match drill and anchor sizes . . . you know the hole is drilled to the right depth for the anchor. *Develops highest holding power* . . . a 7/8" Saber-Tooth holds nine tons! All-steel construction resists shock, vibration, fire, rust. UL, FM approved, in full range of sizes and styles, including 3/16" snap-off flush-type, especially for electrical work.

RAWL SPRING-WINGS

Automatic Spring Action Toggle Bolts

Rawl Toggle Bolts are rustproof and have a positive automatic spring action for easy installation in Hollow Walls, Pressed Board Walls, Tile, Sheet Metal, etc.



RAWL CALK-INS

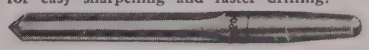
Machine Screw Caulking Anchors

Improved machine screw anchor. Sleeve is precision-cast of Rawloy, exclusive lead alloy especially developed for masonry anchors—Just soft enough for easy, complete caulking and hard enough for tremendous holding power.
FREE caulking tool included in every box.

RAWL DRILLS

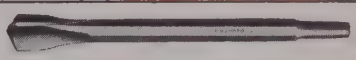
and accessories

All Rawl percussion drills are three pointed for easy sharpening and faster drilling.

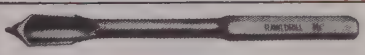


MACHINED (M/T)

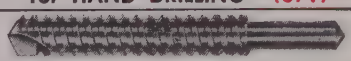
TWIST TYPE (R/T)



FORGED TAPER-SHANK DRILLS for POWER HAMMERS (T/S)



FORGED DRILLS for HAND DRILLING (S/T)



RAWL SPIRAL CARBIDE DRILLS

RAWLDRILL Accessories

RAWL DRILL-HAMMER

Quickly converts a 1/4" high speed electric drill to a fast power hammer.
Weight—2 3/4 pounds. Weight of blow—adjustable to "light," "medium" or "heavy." Construction — only three moving parts all of hardened steel. Designed to withstand the most severe treatment. Capacity—Rawl #14 adapter for No. 6 (5/32") to No. 14 (9/32") Rawldrills (M/T or R/T). Rawl #20 adapter for No. 16 (5/16") to No. 20 (3/8") Rawldrills (M/T or R/T).

The RAWLPLUG Company, Inc.

Anchoring and drilling devices for fastening anything to masonry

To help him help you solve your masonry anchoring problems, your Graybar representative has been specially trained by Rawlplug, and he has your FREE copy of the handy new pocket-size 48-page "Masonry Anchoring Handbook," the most complete source of information on the subject. Ask him for it, or write

The RAWLPLUG Company, Inc.
205 Petersville Road,
New Rochelle, N. Y.

Please rush my free copy of the "Masonry Anchoring Handbook."

Name .....

Firm .....

Address .....

TOP QUALITY PRODUCTS . . . Distributed by Graybar

Venetian Blind Manufacturing Co., Chicago, Ill. Architect: Harold A. Stahl, Chicago, Ill. Builder: Larson & Stoneberg, Park Ridge, Ill. Electrical Contractor: Circle Electric Company, Inc., Chicag

John R. Lauria, Electrical Contractor, uses

Republic ELECTRUNITE® Electrical Metallic Tubing Because..

THE BEST COSTS LESS INSTALLED

REPUBLIC STEEL
STEEL AND TUBES DIVISION
Cleveland 8, Ohio

TOP QUALITY PRODUCTS . . . Distributed by GraybaR

Columbus 1-4999

CIRCLE ELECTRIC CO. INC.

Commercial -:- Residential -:- Industrial
Wiring Power and Light

5511 WEST DIVISION STREET
CHICAGO 51, ILLINOIS

December 28, 1959

Mr. Harry M. Henderson
District Sales Representative
Republic Steel Corporation
322 South Michigan Avenue
Chicago 4, Illinois

Dear Harry:

We just finished another installation where we used Republic ELECTRUNITE E.M.T. and the job went so smoothly, I thought I would drop a line and tell you how pleased we are with your product.

I have been using ELECTRUNITE for eleven years. During that time I have tried other brands, but none came up to the high quality of ELECTRUNITE.

Labor is a prime factor to any electrical contractor. I find ELECTRUNITE bends easier, goes in easier, and does not kink. The "Inch-Marks" and "Guide-Lines" are a big help. They eliminate guesswork and the need for a ruler. The exposed work of the finished job is neater.

Last but not least, the most important feature of ELECTRUNITE is the Silver-slick inside finish. We find this new finish combined with "Inside-Knurling" cuts wire pulling time at least one-third.

We just can't praise Republic ELECTRUNITE enough.

Very truly yours,

John R Lauria

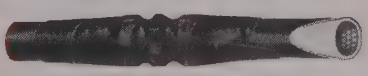
CIRCLE ELECTRIC CO., INC.
John R. Lauria, President

JRL:cvw

COMPLETE LINE . . . REPUBLIC ELECTRICAL CONDUIT PRODUCTS

GALVITE® RIGID STEEL CONDUIT (Blue Label) is a heavy wall hot dipped galvanized conduit with a special coat of baked-on lacquer inside and out for greater corrosion-resistance and long life.

ENAMELITE® RIGID STEEL CONDUIT (Red Label) heavy wall conduit is protected inside and out with a baked-on coating of tough, wear-resistant enamel for greater protection against moderate corrosive action.



REPUBLIC "DEKORON®-COATED" E.M.T. is the plastic armored raceway recommended for use in severe corrosive conditions of service. Outlasts standard conduit 10-to-1. Easy to install, no special tools, no special fittings.

"DEKORON-COATED" RIGID STEEL CONDUIT is the heavy wall raceway that shrugs off corrosion. Tough coating of polyethylene encases Galvite Rigid Steel Conduit in an end-to-end armor for protection in severe corrosive conditions of service.

REPUBLIC BENDING TOOLS are designed and engineered to help the contractor make accurate predetermined bends in Republic raceway installations. Avoid costly "wows", wasted time, and wasted material. Send for The Bending System Booklet.

TOP QUALITY PRODUCTS . . .

Distributed by GraybaR

Your Revere wholesaler offers matched, easy-to-install equipment for every outdoor lighting job

Revere offers the widest selection of high-quality outdoor lighting equipment available from any single manufacturer . . . floodlights, luminaires, poles and all accessories. Every component you select is design-matched to every other component for easy installation, structural strength and balance, and peak lighting efficiency. Ask your Revere wholesaler about the advantages of Revere incandescent, mercury, or fluorescent outdoor lighting for your next job. You'll be pleased with on-time delivery of components to your job schedule . . . you'll be pleased with the way design-matched Revere equipment reduces call-backs.

Revere® ELECTRIC MFG. CO.

OUTDOOR LIGHTING EQUIPMENT

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Ill.

Long Distance Phone: NIles 7-6060 • Chicago Phone: SPring 4-1200

1. **Revere Ultra-Lites** *are attractive and efficient for illuminating large areas brightly and uniformly. Each Ultra-Lite houses four 400-watt mercury lamps positioned to throw a square light pattern with wide coverage that cuts pole requirements 50 to 75%.*

2. **Endoval luminaires** *are used to light shopping-center parking lots, automobile sales lots, store fronts and similar applications where high intensity, glare-free light is desired. Uses 250 or 400-watt mercury lamps.*

3. **Revere hinged poles** *make for safe, economical lamp maintenance at ground level. Eliminates need for boom trucks or ladders.*

4. **4200 Series** *floodlights provide efficient large-area lighting for sporting fields, storage yards, buildings, etc., using 750, 1000, or 1500-watt incandescent lamps with wide or narrow-beam reflector.*

5. **7400 Series** *floodlights use 1000-watt mercury lamps to provide exceptionally high light output for railroad yards, sports fields, parking lots and other large-area applications.*

6. **3800 Series** *Eliptor floodlights are an economical source of high intensity lighting for smaller area, general-purpose applications. Eliptor floodlights are available for 300- to 1500-watt incandescent lamps.*

7. **3151 Series** *underneath floodlight provides unusually attractive lighting effects for buildings or other vertical surfaces.*

8. **Fluoresign** *outdoor luminaire is highly efficient, economical way to illuminate poster panels, store fronts, highway signs, painted walls and other surfaces, using HO, VHO, SHO or Power Groove lamps.*

TOP QUALITY PRODUCTS . . .

Distributed by GRAYBAR

SAVE THREE WAYS WITH

Shure-Set®

HAMMER-IN FASTENING TOOL

FASTEN TO CONCRETE OR BUILDING BLOCK QUICKER AND EASIER

Shure-Set, the unique new hammer-powered fastening tool, sets drive pins and threaded studs in concrete, masonry, and other hard materials with a few quick hammer blows. It handles tiresome light-fastening jobs without messy drilling or costly, time-consuming plugging.

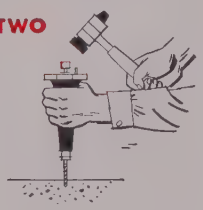
With Shure-Set you can fur a concrete wall, fasten conduit, anchor switch boxes, fasten window frames and do a hundred-and-one other jobs quickly, easily and professionally. It grips and guides fasteners with pin-point accuracy . . . prevents bend, buckle and bounce. Check into this versatile tool today.

ONE

Fastens

Sets threaded studs and drive pins into concrete, masonry and other hard materials . . . quickly, accurately and easily.

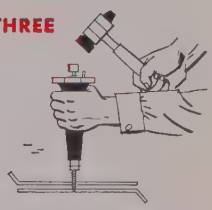
TWO



Drills

Where drilling is still necessary, Shure-Set tool accommodates drill-holder and tapered masonry drill. Follow usual procedure of "tap and twist".

THREE



Sets Sheet Metal Screws

Special Skrew-Set attachment allows you to fasten pre-drilled objects to light-gauge metal. Shanks are pointed and threaded . . . just punch and turn.

FOR HEAVY-DUTY FASTENING, YOU CAN'T BEAT

Ramset®

Where plans call for heavy-duty fastening, the powder-actuated Ramset System works best. Ramset fastens studs and pins into concrete, steel and other hard materials with one quick pull of a trigger.

Shure-Set another product of:

Ramset Fastening System

WINCHESTER-WESTERN DIV. • OLIN MATHIESON CHEMICAL CORP.
285-D WINCHESTER AVE. • NEW HAVEN 4, CONNECTICUT

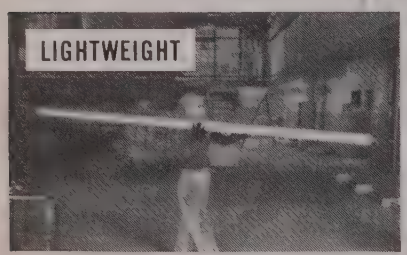
TOP QUALITY PRODUCTS . . . Distributed by GraybaR

Reynolds Aluminum Rigid Conduit LOWERS INSTALLATION COSTS

Here's why: Reynolds Aluminum conduit bends and forms easily and accurately. And, because aluminum is so lightweight—weighing one-third as much as steel, it can be handled and installed easily. Important to everyone concerned with maintenance is the fact that aluminum can't rust ever—and also resists corrosion due to weather and most industrial atmospheres. Even threads cut on the job can't rust.

Reynolds Aluminum Rigid Conduit is non-magnetic, reduces voltage drop, makes longer runs or smaller conductors possible.

For complete information and names of Reynolds Aluminum Rigid Conduit distributors, call your Reynolds Sales Office or write *Reynolds Metals Company, Box 2346-ET, Richmond 18, Va.*



Watch Reynolds TV shows "ADVENTURES IN PARADISE", "BOURBON STREET BEAT" and "ALL STAR GOLF"—ABC-TV

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Pick the floor that has I L C*

*Indirect
Luminous
Ceiling
BY SILVRAY

National Cash Register Company, Dayton, Ohio

You're right — it's the second floor. And NCR was right to choose ILC for re-lighting this entire space. Now the draftsmen who work here enjoy 140-foot-candles illumination without glare. Individual board lamps are no longer necessary.

For details of a complete "easy selling" plan featuring ILC "Seeing Systems", mail this coupon.

To: Silvray Lighting, Inc.
100 West Main Street
Bound Brook, N. J.
Dept. 46E

Name_____

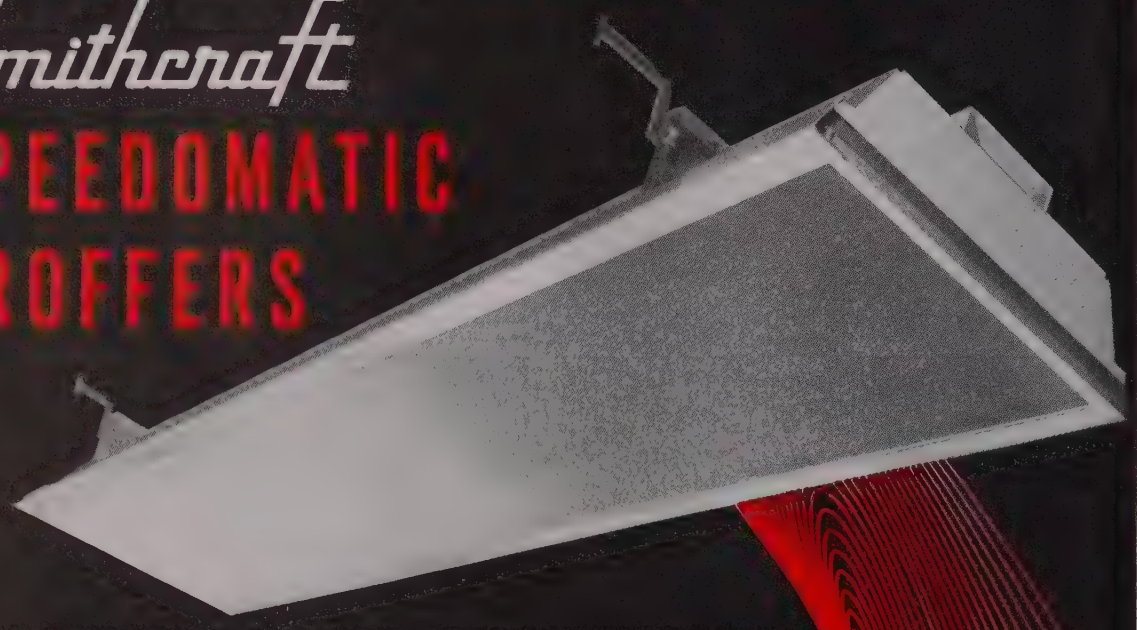
Company_____

Address_____

City & State_____

TOP QUALITY PRODUCTS . . . Distributed by GrayBar

make EXTRA money with Smithcraft SPEEDOMATIC TROFFERS



Smithcraft Speedomatic Troffers make extra money for you on installation after installation, with these time-saving, contractor-minded features:

One-man installation — only required tool is a screwdriver.

Self-aligns to fit ⅛" variance in ceiling openings. Door frame adjusts as easily as a telescope.

Only 4 13/16" deep, allowing maximum room for utilities.

Fast, easy wiring, with large wiring access door, wireway and end openings.

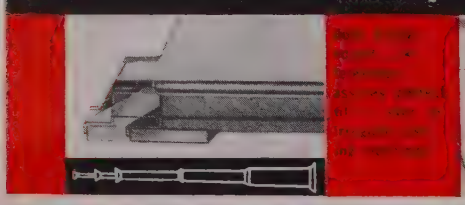
Four basic types fit 101 ceiling systems.

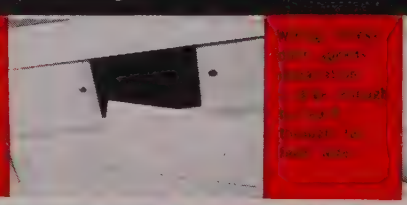
Packed two to a carton for faster installation, with or without door frame installed.

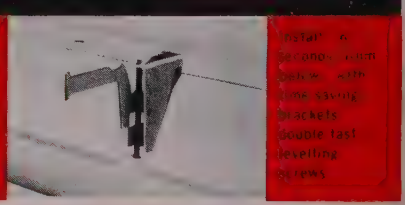
Light-conditioning by Smithcraft — America's finest fluorescent lighting

Smithcraft Lighting

CHELSEA 50, MASSACHUSETTS







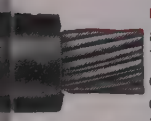
TOP QUALITY PRODUCTS . . .

Distributed by GRAYBAR

Simplex PRODUCTS GUIDE

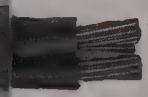
SIMPLEX WIRE & CABLE CO.
CAMBRIDGE 39, MASS., U.S.A.

Simplex ANHYDREX Insulated Cables for Power transmission and Communication (like the Simplex TIREX Portable Cords and Cables shown in adjacent column), though manufactured as stock products, are custom designed to suit all service requirements. A large technical and engineering staff at Simplex' main plant is equipped to give you the benefits of their long experience in electrical cable planning.



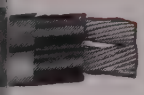
ANHYDROPRENE — Simplex ANHYDROPRENE Cables are designed for economical installation in ducts, conduits, racks, trays and raceways. Stock sizes AWG 14 to 1000 MCM are recommended for 90 C service in WET or DRY locations. The words "Simplex ANHYDROPRENE" are either printed or molded plainly on the jackets of all ANHYDROPRENE cables. This marking signifies the traditionally high quality of a Simplex product.

CATALOGUE #1028



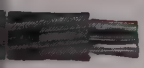
ANHYDREX-NEOPRENE — Simplex ANHYDREX-NEOPRENE Cables have the added mechanical protection of a heavy wall of neoprene jacketing. These cables are manufactured for use in aerial installations and for direct burial service. Stock sizes AWG 14 to 1000 MCM are recommended for 90 C service in WET or DRY locations.

CATALOGUE #1028



ANHYDREX-PLASTEX — Simplex ANHYDREX-PLASTEX (ANHYDREX-insulated, PLASTEX-jacketed) Cables are scientifically designed for compatibility between insulation and jacket, and for perfectly balanced performance in ducts, conduits, aerial and direct burial installations. ANHYDREX-PLASTEX Cables are recommended for service in a number of environments but especially where oils and chemicals are a problem.

CATALOGUE #1028

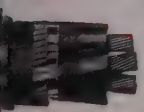


ANHYDREX Insulated Control Cables — Simplex ANHYDREX Control, Signal and Communication Cables have an additional thickness of appropriately coded neoprene over each individual conductor, plus heavy-duty neoprene jackets. ANHYDREX insulation provides excellent signal reproduction and is exceptionally stable, even when operating with high ambient temperatures.

CATALOGUE #1028

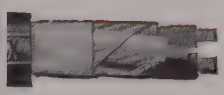
ANHYDREX XX — Simplex ANHYDREX XX is a butyl-based insulation of the highest possible quality. Because of its exceptional resistance to heat and ozone, it has general applications in circuits operating up to 35,000 volts, with permissible conductor temperatures of 90 C. to 5KV, and 85 C to 17KV — in wet or dry locations.

CATALOGUE #1023



CONDEX — Simplex CONDEX Cables are protected against mechanical damage by interlocked metallic armor. The armor is manufactured of galvanized steel, plain or baked enameled (colored) aluminum, bronze or other metals, and can be applied over any cable core within a very wide diameter range. CONDEX Cables may be further protected by a thermoplastic covering over or under the metallic armor.

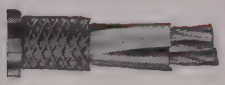
CATALOGUE #1024



TIREX SO and SJO Cords — TIREX SO and SJO Cords are constructed to meet the most rigid specifications. All of their special features are carefully selected and processed to give maximum qualifications for portable service. They will twist without kinking, and bend without breaking. TIREX stranding affords maximum flexibility without sacrificing strength.

Conductor temperature rating 75c

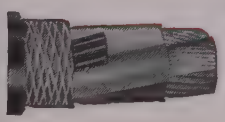
CATALOGUE #992



TIREX Low Voltage Portable Cables — TIREX Low Voltage Cables are individually designed for specific applications. They are practically indestructible when used to do the work for which they are intended

Conductor temperature rating 75c

CATALOGUES #992 & #1011



TIREX High Voltage Portable Cables — TIREX High Voltage Portable Cables have unequaled strength and versatility. Designed primarily to transmit energy to mobile electrical equipment, they are also used as temporary power lines during alterations or emergency repairs.

Conductor temperature rating 75c

CATALOGUE #1012

TIREX Mine Locomotive Cables — TIREX Mine Locomotive Cables — both single and two-conductor concentric — are approved by the Bureau of Mines and have the raised marking "P-101 BM" on their heavy-duty neoprene jackets. All TIREX Cables are cured and conditioned for service in lead.

Conductor temperature rating 75c

CATALOGUE #1011

TIREX Mining Machine and Shuttle Car Cables — TIREX Mining Machine and Shuttle Car Cables are designed for stability under today's rigorous mining conditions. The insulated conductors are "ribbed" or gear-shaped. This feature causes them to interlock with the heavy duty neoprene jacket and prevents them from slipping. Both Type W and Type G have "P-101 BM" molded onto the jacket.

Conductor temperature rating 75c

CATALOGUE #1011

TIREX Dredge and Shovel Cables — TIREX Dredge and Shovel Cables are masterpieces of engineering achievement. Every consideration has been given to safety and durability. Simplex special cured-in-lead neoprene armor effectively resists all the elements normally encountered in this type of work.

Conductor temperature rating 75c

CATALOGUE #1012

TIREX Welding Cables —TIREX Welding Cables are scientifically stranded for maximum flexibility without wrist drag. Cured-in-lead neoprene jackets provide utmost safety for both operator and bystanders.

Conductor temperature rating 75c

CATALOGUE #1011

TOP QUALITY PRODUCTS . . .

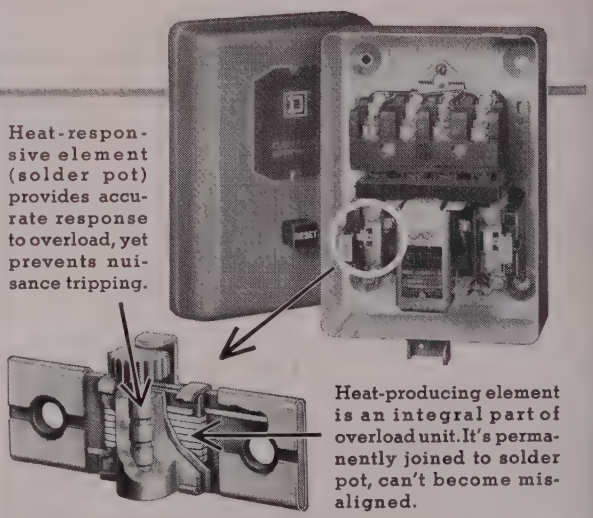
Distributed by Graybar

ONLY SQUARE D STARTERS WITH 1-PIECE OVERLOAD RELAYS GIVE *Absolute* PROTECTION!

• Only Square D makes thermal overload relays with 1-piece construction—and only with 1-piece construction can you *know* you've installed the heater correctly. Square D 1-piece overload relays can be installed only one way. They are factory-assembled, individually tested and calibrated, completely tamper-proof. Repeated tripping will not affect accuracy.

You *pay* for overload protection—be sure you *get* it. Insist on Square D 1-piece overload relays for *absolute* protection.

D EXCLUSIVE—
1-piece Overload Relay for *ABSOLUTE* Protection!



STARTERS and other Square D Products are distributed by GRAYBAR

SQUARE D COMPANY

wherever electricity is distributed and controlled

TOP QUALITY PRODUCTS . . .

Distributed by GRAYBAR

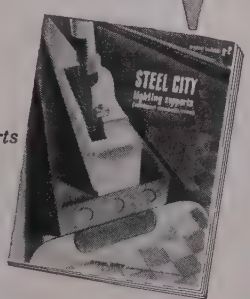
* SURFACE RACEWAY SYSTEM

Specially designed for use as a combination surface raceway and flush-mounting fluorescent fixture support. Completely enclosed from outlet box to fixture to eliminate the clutter of external conductors, this system also protects the wiring from physical damage. It's simple "slot-up" design makes it easy to install . . . easy to wire.

SIMPLEX SYSTEM

A fluorescent fixture *support* system only, its channel is applied slot-side down, and is not intended for use as a raceway. This system combines economy of investment with maximum strength and rigidity. It is easy to install and fixtures may be attached, or relocated, without lowering, or otherwise disturbing the basic channel assembly.

Write for our product bulletin g-2. "STEEL CITY lighting supports (Kindorf channel type)."



designed by electrical engineers
made by a leading electrical manufacturer
for the electrical trade.

products of

STEEL CITY
ELECTRIC COMPANY

PITTSBURGH 33, PA.

TOP QUALITY PRODUCTS . . . Distributed by Graybar

Thor

Everything you want in Electric Drills . . .

and more!

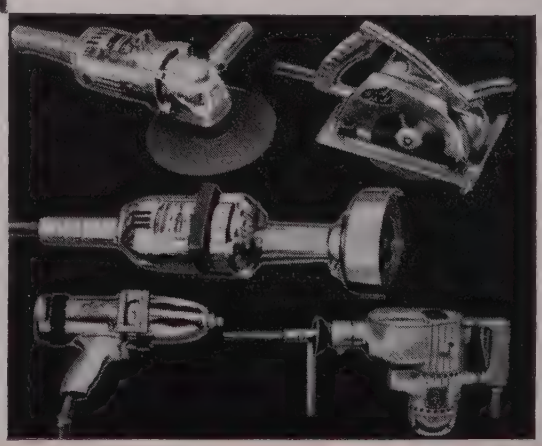
Thor's series of universal electric drills have earned an enviable reputation for high quality and outstanding performance. Standouts wherever quality and reserve power are needed. All ball-bearing construction and Thor-built motors assure long, trouble-free life on the job. In ¼" to 1¼" capacities. Complete range of speeds, angle attachments and accessories. Thor Power Tool Company, Aurora, Illinois. Branches in all principal cities.

Thor POWER TOOLS

Thor

Everything you want in Electric Tools...*and more!*

Sixty-five years in the tool business has taught us everything about building quality into our whole range of products—drills, impact wrenches, grinders, screwdrivers and nut setters and saws. We make tools better and service them better through a network of twenty-three branch offices and qualified distributors.



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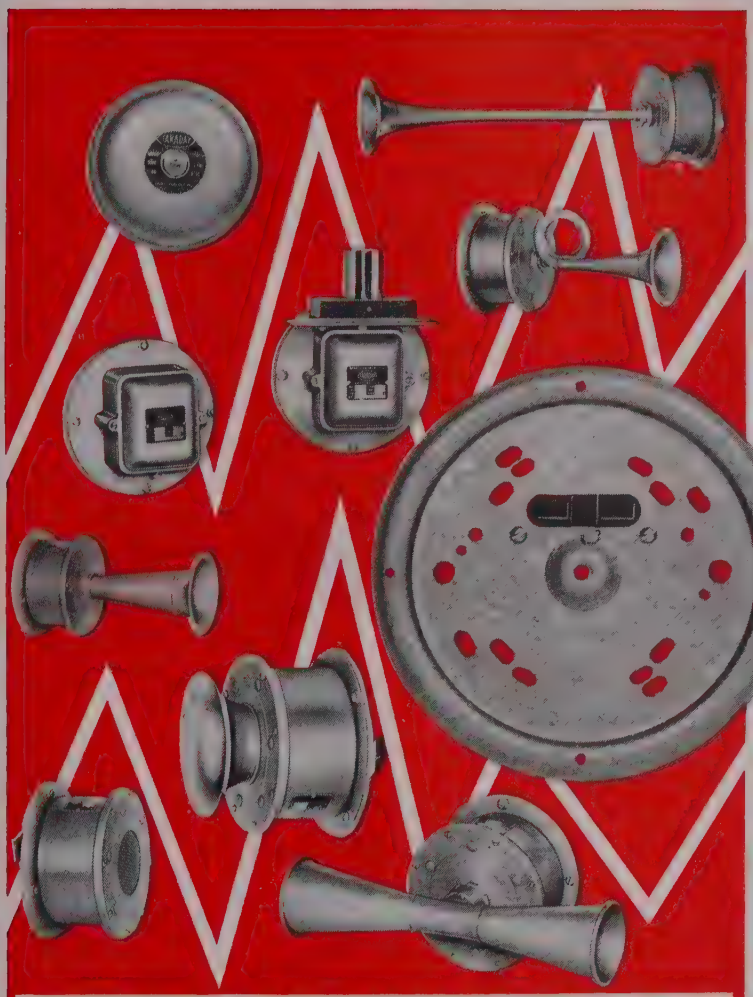
INTERCHANGE SIGNALS QUICKLY, EASILY...



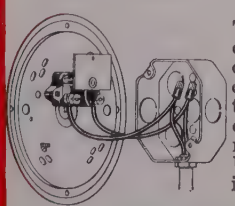
One Uni-Pact Adapter Plate fits 12 different signals

Before you buy another signal, consider the tremendous advantages of a Uni-Pact installation. This unique adapter plate permits almost instant interchangeability of any of a dozen different signals. This is important where noise levels may change. For example, a room that was formerly a store room may be converted into a machine shop. The soft chime, that was formerly satisfactory, cannot be heard above the clank of metal or whining of machinery. With Uni-Pact, you merely pull out the chime and install a bell or horn. And this can be accomplished with nothing more than a screwdriver. Here are the four easy steps for quickly interchanging Uni-Pact signals:

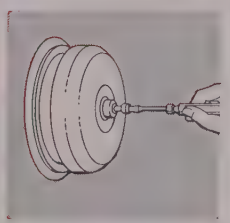
THE UNI-PACT ADAPTER PLATE WILL ACCOMMODATE ALL THESE SIGNALS

- **HORNS,** all types: megaphone, short projector, two-way projector, drum style or Kodaire with straight or loop projector.
- **BELLS,** 6" and 10" sizes, single stroke and vibrating models.
- **BUZZERS** • **CHIMES**

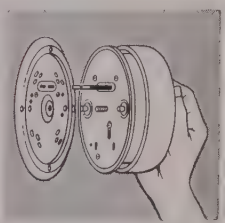
AC or DC models. For surface mounting, or panel or switchboard installations.



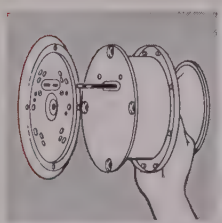
The Uni-Pact Dead Front Adapter Plate is designed for easy mounting over a standard outlet box, wire-mold or condulet. Wires are connected to the back. There are no exposed terminals on the front, so signals can be interchanged in complete safety. On new work, the rough-in men can complete connections to the Uni-Pact plate and the signals can be plugged in later.



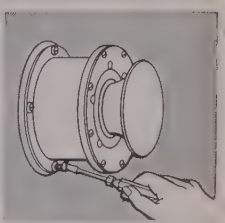
The retaining screw is loosened...



the old signal is pulled out...



the new signal is easily plugged into the Uni-Pact plate...



the retaining screws are tightened and the job is finished in just moments.

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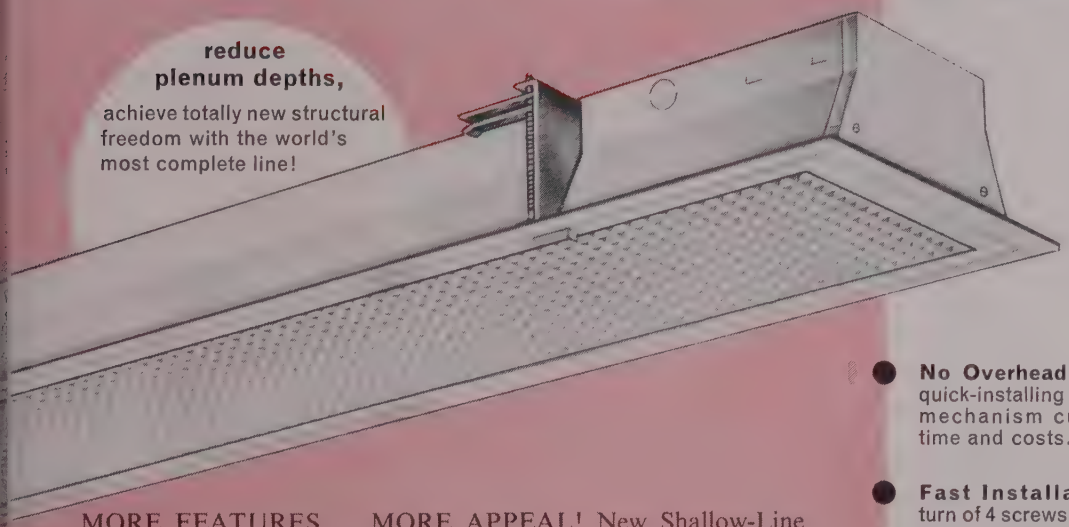
reduce plenum depths,
achieve totally new structural freedom with the world's most complete line!



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- **New One-Piece Housing**—unitized 4′ and 8′ fixtures possess maximum structural strength.
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2′ x 4′ Troffer with Holophane #6025 Lens.

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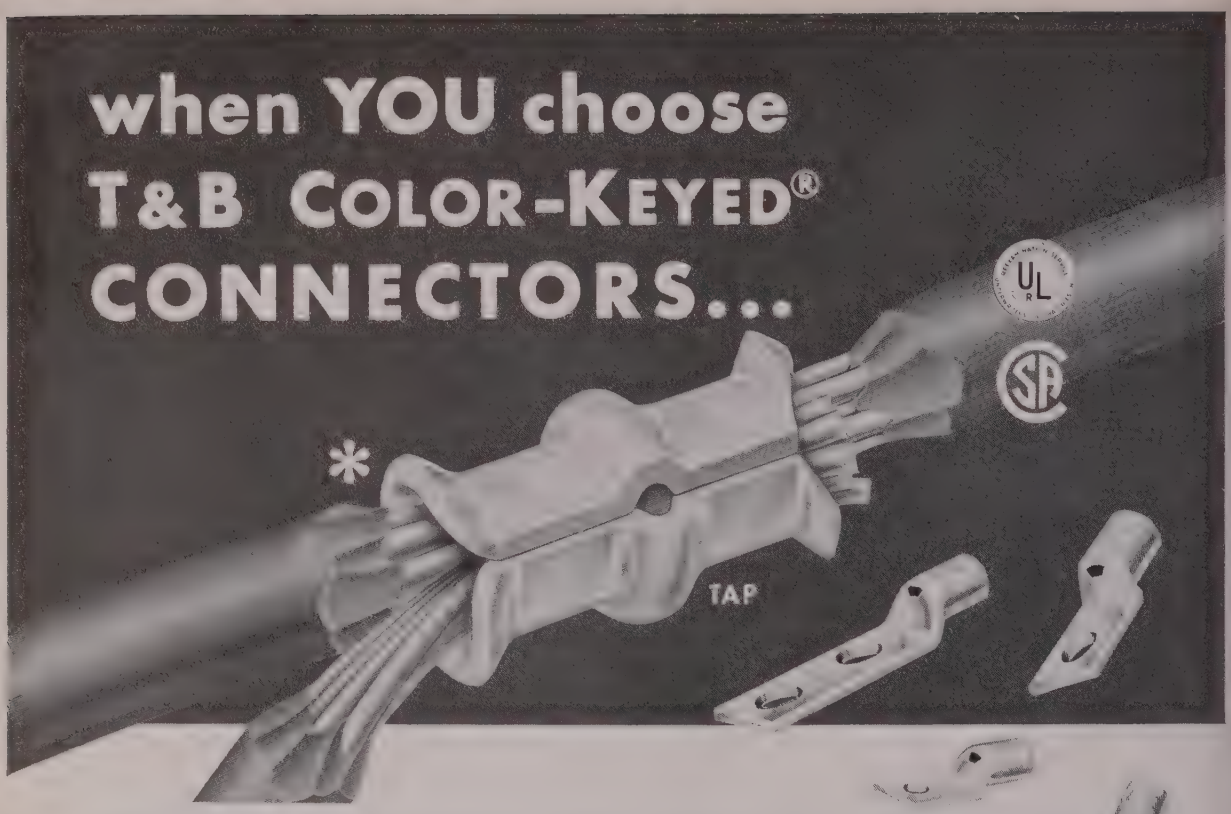

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THE NEW TBM8 HAND TOOL

The only hand tool that installs connectors from #8AWG to 500MCM.

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TOLEDO OFFERS YOU THE BEST TOOLS HAND OR POWER

FOR CONDUIT and PIPE OPERATIONS THREADING . . . CUTTING . . . REAMING

HAND TOOLS . . . Quality made, quality checked, the TOLEDO brand name insures you that invested dollars in TOLEDO TOOLS will add job-profit dollars through longer, dependable service life and better on-job performance. TOLEDO Cutters, Wrenches, Reamers, Vises and Vise Stands are all performance engineered to operate smoothly, more efficiently and faster. There's a TOLEDO HAND TOOL to suit your particular need in job operations on conduit pipe, bolt and rod-stock.

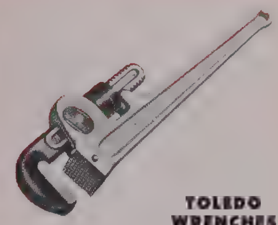
POWER DRIVES . . . TOLEDO designed, TOLEDO engineered and precision built to give you the lasting service life and dependable operation that adds to job-profit dollars. All new, the TOLEDO "58" Power Drive converts your hand tools to power tools instantly. It weighs only 73 lbs., making transportation easy. The TOLEDO "68" portable turns die stocks, opens and closes valves, operates hoists and winches, operates tapping machines, operates earth augers, replaces hand cranking on almost any job.

POWER MACHINES . . . Ready to go to work to perform cutting, reaming and threading operations on up to 2″ conduit or pipe, and up to 1½″ bolt or rod stock. The improved, all new TOLEDO "98" and TOLEDO "999" are priced economically, and designed for easy transportation in the shop or to-the-job. TOLEDO "1-2-4" model, Heavy Duty Power Pipe Machine handles 1″ thru 4″ sizes. Other TOLEDO Power Pipe Machines are also available.

TUBING TOOLS . . . For hard drawn, in addition to soft temper copper, brass, aluminum and other metal tubing sizes ⅛″ through 4″ O.D. TOLED-O-MATIC Tubing Cutters have quick slide-to-size adjustment. TOLEDO Lever-type Benders enable you to bend ¼″ thru ⅞″ O.D. tubing to any angle desired thru 180°. Spring-type Benders also available. TOLEDO Flaring Tools handle tubing sizes ⅛″ thru 1⅛″ O.D. TOLEDO Swaging Tools available for ⅛″ thru ⅞″ sizes. No. 1 TOLED-O-MATIC BUFF-EZY MACHINE cleans and deburrs all copper tubing and fitting sizes thru 4″. Precision built, priced low, it eliminates costly hand work, insures lifetime joints eliminating line leaks.

PIPE CUTTERS

⅛″ to 2″ capacities. Track perfectly, cut cleanly.



TOLEDO WRENCHES

6″ to 48″ sizes—⅛″ to 6″ capacities. Heavy duty.

CHAIN WRENCHES

½″ to 6″ capacities; powerful, lightweight, fast-acting.

TUBE CUTTERS

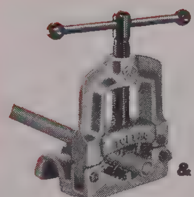
For ⅛ thru 4⅛″ O.D. sizes, for fast, clean cuts.

SMALL RATCHET PIPE THREADER

Wide choice of die heads. Three models ⅛″ through 2″. Ideal for close corners.

No. 68 PORTABLE POWER-DRIVE

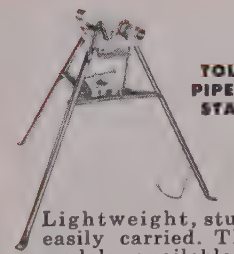
Handiest tool to own—pull, lift, crank, turn. Has a dozen uses with all popular die stocks.



TOLEDO PIPE & CONDUIT VISE

No. 22 & No. 25

For ⅛″ to 4″ sizes, new type frame is extra strong.



TOLEDO PIPE VISE STANDS

Lightweight, sturdy, easily carried. Three models available.

POWER DRIVE No. 58

Converts hand tools to power. Weighs only 73 lbs., for all pipe sizes up to 2″ diameter.

No. 98 CUTTING, THREADING, REAMING ⅛″ TO 2″ PIPE

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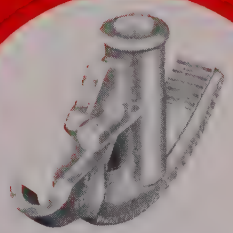

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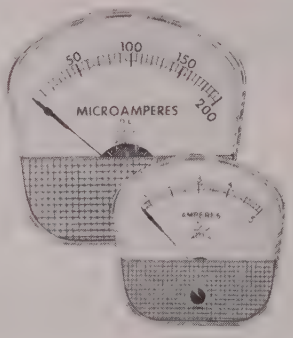
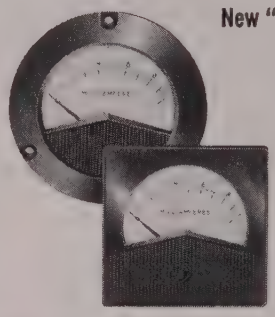
PANEL INSTRUMENTS by Weston: fine instrumentation at economy prices. The full line includes these famous series:

The new "CROWN" line

A new 4½-inch series has been added to the 2½-inch Crown Line and the 2½-inch model is now offered as an A-C instrument as well as D-C. These handsome long-scale instruments also equipped with CORMAG® mechanisms. Case design permits all-around natural scale illumination. Ultra-modern styling to enhance the finest panels or equipment.





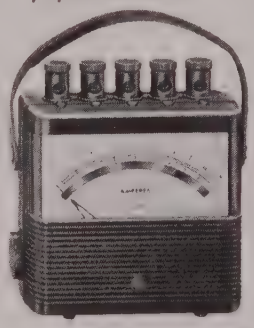
New "201" and "301" instruments

All 2½-inch "201" and 3½-inch "301" models now equipped with CORMAG self-shielded mechanisms . . . immune to magnetic intereffects . . . can be mounted interchangeably on magnetic or non-magnetic panels. Newly styled for improved appearance and readability in both round and rectangular cases.

PORTABLE INSTRUMENTS: designed and built in the exacting tradition of Weston engineering and craftsmanship. Among them, these popular models:

"904 GROUP" portables

Multi-range A-C instruments with self-contained transformers. Rated accuracies: 0.5% of full scale value. Easy-to-read, 5½-inch hand calibrated mirror scales, with knife-edge pointers. Exceptionally well shielded from external magnetic fields. Modern, all-bakelite cases with curved, wide-angle windows.



Model 633 CLAMP VOLT-AMMETERS

Measure A-C currents up to 2000 amps . . . 700 volts . . . assuring accuracies within 3% of full scale values. Their range, reliability and safety have earned their acceptance as standards by major utilities. Flexible potential leads are supplied as standard accessories. Also available — pocket size Model 749 — Type VA-1.

TEST EQUIPMENT by Weston: recognized standards of precision and stability. Science and industry rely on such advanced units as these:

Model 980 MARK II ANALYZER

Newly increased ruggedness and compactness distinguish this highly sensitive Volt-Ohm-Milliammeter. With high-voltage range extended to 4000 volts, offers D-C sensitivity of 20,000 ohms/volt . . . accuracy within ± 2%. Single dial control for range and function switching. CORMAG mechanism with spring-backed jeweled movement. Fuse protected ohm ranges.

Model 639 INDUSTRIAL ANALYZER

The most complete, self-contained portable analyzer available. Measures A-C current, voltage, power . . . in single and polyphase circuits . . . also power factor in 3 phase, 3 wire, balanced circuits. Compact and lightweight, with all interconnections within the unit. Insulated for 1000 volt service. ± 1% accuracies for voltage, current, power factor . . . ± 2% for wattage.

For further information contact your nearby Graybar office. *In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 19, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*

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World leader in measurement and control

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WELLS OFFERS TWO COMPLETELY MOBILE DUAL PURPOSE, METAL CUTTING BAND SAWS

Now you can handle Horizontal Cut-off Work and Vertical Bandsawing with ONE Wells Saw

MODEL 49-A — With heavy duty, rubber tired, ball bearing wheels, and one piece fold-down handle (optional equipment), the Wells Model 49-A is a metal cutting band saw that's really mobile . . . that can be wheeled wherever needed . . . quickly . . . easily.

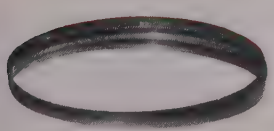
The 49-A is a dual purpose saw. As a horizontal cut-off machine, it has a capacity of 3½" x 6". Swing the head into vertical position . . . it becomes an upright band saw for cutting angles, slots, notches, bevels and contour work. Ample power, 3-speed V-belt drive and sturdy construction assure smooth, even cutting. You'll find the Wells Model 49-A ideally suited for shop or "job-site" work. For full details, ask for Bulletin 253-H.

MODEL 58-B — Here's the all new metal saw you've been asking for . . . designed and built to give you double duty — double value. Compact . . . rugged . . . well guarded . . . the Wells Model 58-B is an extremely versatile unit at an economical price.

As a horizontal cut-off saw, the 58-B has a capacity of 6" x 10" on rectangular shapes; 6" on rounds. It features a quick action vise (swivels to 45°), automatic shut-off and adjustable blade guides.

For vertical use, just swing the head into upright position and install the work table (optional equipment).

Other optional equipment includes a wheel-handle unit to provide complete mobility and a stock-stop assembly for repetitive cutting of identical lengths. Request Bulletin 262.



BAND SAW BLADES

Blades for Wells Model 49-A (½" x 60") and Model 58-B (½" x 93") are available in the following specifications: Raker Set—6, 10, 14, 18 and 24 teeth per inch; Wavy Set—10 and 14 teeth per inch.

STOCK STANDS

Wells Stock Stands will repay their modest original cost many times over in convenience and ease of handling long pieces of stock. Wells design assures easy action and speeds up production by reducing stock shifting time. Two models are available.

Wells SAWS

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The Pioneers of Horizontal

METAL CUTTING BAND SAWS

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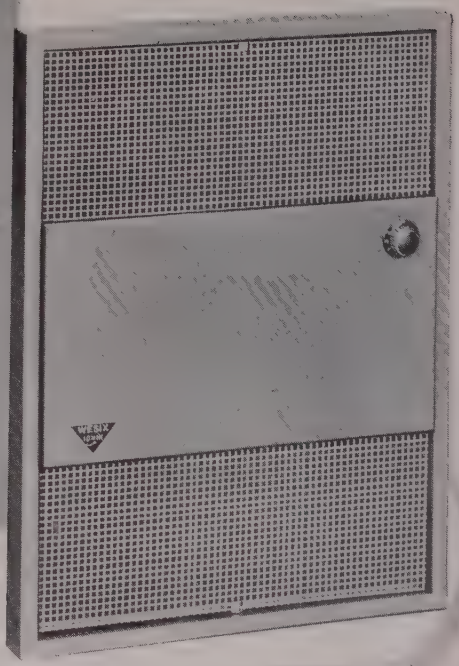
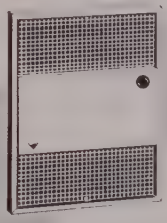
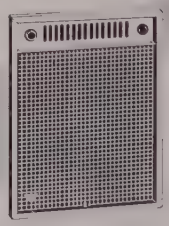


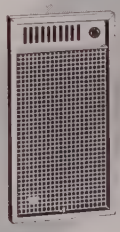
When you select NEW electric heating by WESIX-IONIX you choose a selling feature for any house. For here, in a system that's easiest of all to install in new or older homes, WESIX offers exclusive ion-balanced, comfort conditioned living.

Now you can offer *easier breathing, better health* and *perfect comfort.* Now room air stays fresh without that winter-stuffy feeling. Now your homes stay clean and free from airborne bacteria, virus and pollens—because WESIX-IONIX destroys 90% of all air-borne organisms.

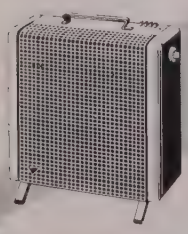


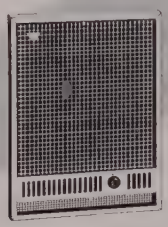


And these new units are designed in styles, types and in price ranges to suit any building need. They're decorator designed and contractor engineered to bring a combination of customer-pleasing beauty and builder-pleasing ease of installation.



Be ready to profit from the growing demand for modern electric heating. Get all the facts on the most modern —Wesix-Ionix. Write for your complete catalog today.





Knowing these simple facts puts you out in front

Negative Ions—tiny particles that can not be seen under even the most powerful of microscopes — have opened new frontiers in the science of comfort and health-conditioning of the air we breathe.

Science has learned that pure air contains a high proportion of negative ions —while stale city air is usually high in positive ions. This excess of positive ions makes breathing difficult and slows up the efficiency of the respiratory system, and can aggravate symptoms of asthma and hay-fever.

Wesix-Ionix research has found ways to reduce positive ions and make air "Ion-balanced" like outdoor air at it's best. This feature is built into all Wesix-Ionix heaters and works with out noise or moving parts and without using *any extra power* to keep the air in any home PURE, FRESH and HEALTHFUL around the clock!

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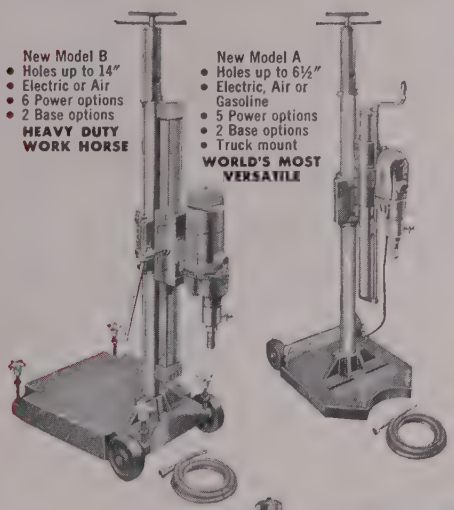
Truco Original Diamond Drill Bits revolutionized masonry drilling by proving savings up to 70%. Sizes ¼" through 20" O.D. Standard lengths 4½" and 12". Other sizes and lengths to order. Full line of accessories.

5 NEW MODELS PLUS POWER COMBINATIONS = 16 MODELS

- Electric, air, gasoline power
- 10 NEW FEATURES of use, economy, performance
- Clean, accurate holes ¼" to 20"
- Roller base, or base plate or truck mounted models. Drill ANYWHERE
- Complete line of engineered, matched accessories
- World's cleanest, quietest, thriftiest hole drilling. No edge patching
- Truco equipment often pays for itself in a single day or on a single job

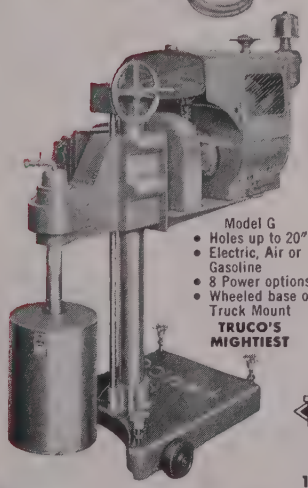


New Model B
- Holes up to 14"
- Electric or Air
- 6 Power options
- 2 Base options

HEAVY DUTY WORK HORSE

New Model A
- Holes up to 6½"
- Electric, Air or Gasoline
- 5 Power options
- 2 Base options
- Truck mount

WORLD'S MOST VERSATILE



Model G
- Holes up to 20"
- Electric, Air or Gasoline
- 8 Power options
- Wheeled base or Truck Mount

TRUCO'S MIGHTIEST

Truck mounted unit swings down into position for accurate, vertical drilling wherever a truck can go. Electric, air or gasoline power.

New Model S Drill Stand and Hand Drill Motor
- Holes up to 5½"
- 3 Power options

LOW COST THRIFT CHAMP

New Drill Kit
- Holes up to 1½"
- Wt. only 17½ lbs.

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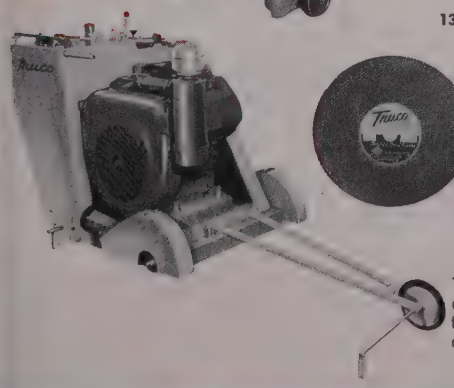

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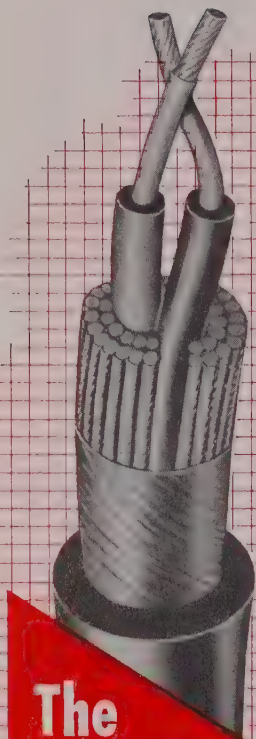

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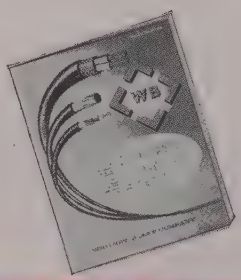

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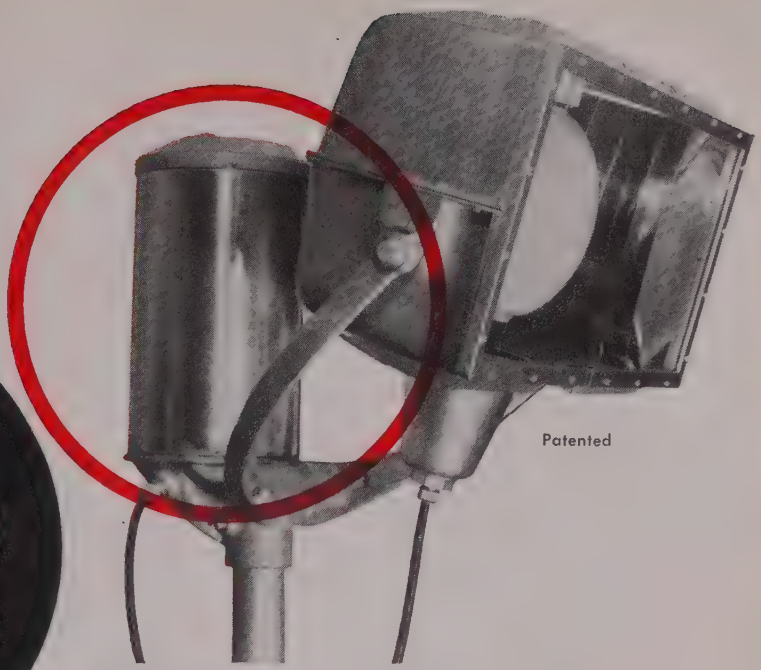

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Look at the advantages Wide-Lite gives you:

- **Exclusive rectangular design** that complements both the length and the diameter of the light source, to give a broad and uniform light pattern.
- **Exclusive segmented reflector** with compound curvature creates a versatile, workable pattern without sacrificing the lamp's unequalled efficiency.
- **Exclusive heat-dissipating fins** limit maximum lamp temperatures to most efficient operating range. Assure retention of color correction and long life.
- **Exclusive three-way lamp protection.** Lamp is protected by *cast aluminum* protective body . . . shock-resistant tempered glass lens . . . and exclusive lamp mounting that secures the lamp at *both* ends.

remote ballast models, too!

Wide-Lites are available with mast fitter only, for use with remotely mounted ballasts. A full line of brackets, hangers and mounts is available to meet any installation requirements.

Models are available for operation in temperatures as low as 65° below zero.

WIDE-LITE CORPORATION

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ELECTRIC COMPANY, INC. 420 Lexington Avenue, New York 17, N

Fluorescents Convert Fargo's Broadway Into a "Whiteway"

Modern fluorescent street lighting system provides four footcandles of whiteway lighting efficiently.

INSTALLATION of 66 of the latest type of fluorescent street lighting luminaires on Broadway, in Fargo, N. D., has transformed that thoroughfare from just another main street into a bright whiteway.

Fargo's Broadway is now nearly five times as bright as it was under the previous filament lamp system; yet it appears less glaring, because of the even, shadowless distribution of light from the new fluorescent luminaires. The new system was designed and specified by the Ulteig Engineering Corporation of Fargo, N. D., and incorporates General Electric Form 406C four-lamp fluorescent luminaires containing four 72-in. extra-high-output Power Groove fluorescent lamps.

"Actually, the incandescents were pretty good compared to many downtown lighting systems in other towns. When installed eleven years ago they supplied about 1.1 footcandles of illumination on Broadway," noted M. T. Ulteig of the engineering firm.

"But, Fargo and its citizens wanted the very latest lighting to dress up the downtown area. The new system provided more than 5 footcandles of illumination when it was installed," he added. "Fargo was recently named one of eleven All-America cities, and we feel the lighting contributed."

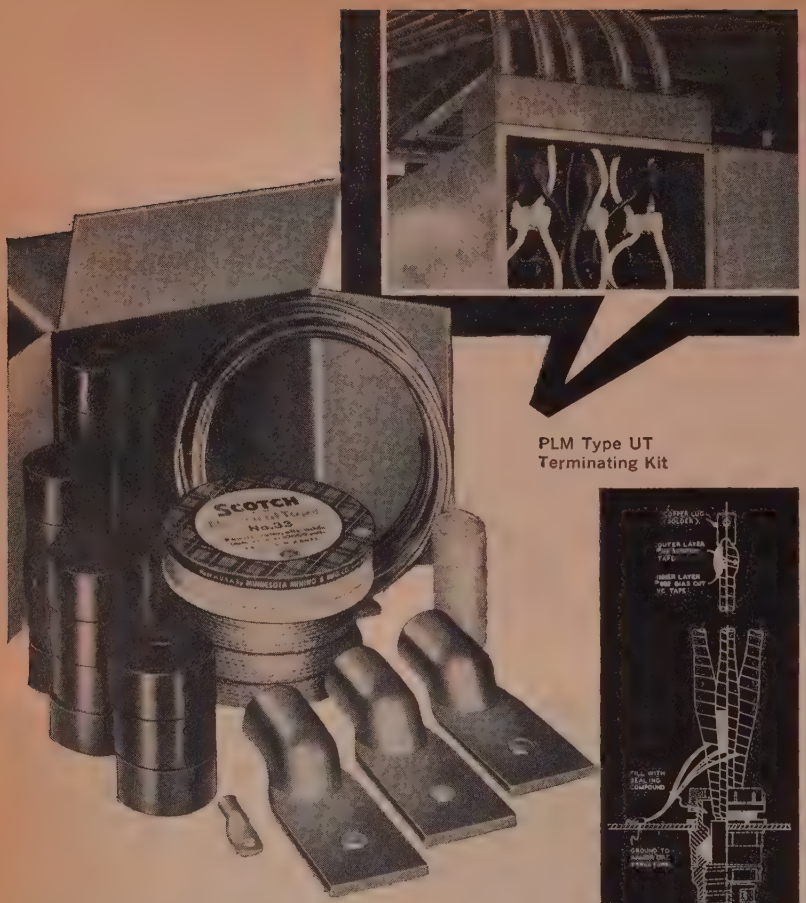
We recommended fluorescent lighting because we wanted to provide maximum safety for pedestrian and vehicular traffic, and still light the front of stores with true color rendition. We wanted sufficient light to give clear visibility of objects and not just a silhouette. At the same time, there should be no glare. We wanted as equal and even distribution of light on the street as possible," Mr. Ulteig said.

From a maintenance point of view, the fluorescents are perhaps the most economical, according to Mr. Ulteig, requiring very little attention once they are installed. Based on local power rates, they provide more lumens per dollar than any other source. The Power Groove lamps provide 10,200 lumens each.

The luminaires are mounted 40 ft apart, 30 ft high, on davit type No. 7 gauge steel standards of sufficient strength to accommodate a luminaire weight of 162 lbs, and withstand a 110-mile-an-hour wind. All standards have festoon outlets. No. 1/0 aluminum is used for the lighting circuit, and No. 2 copper for the festoon circuit, and placed in a 2-in. steel conduit. Six feed points utilizing a total of 20 relays serve the system. Stone Electric

AVERAGE LIGHTING on Broadway in downtown Fargo, N. D., typical of main street lighting in many cities, averaged 1.1 footcandles ("before" view). Then . . .

AFTER RELIGHTING with fluorescent luminaires equipped with 10,200-lumen Power Groove lamps, lighting level was nearly five times as high, visibility greatly improved.



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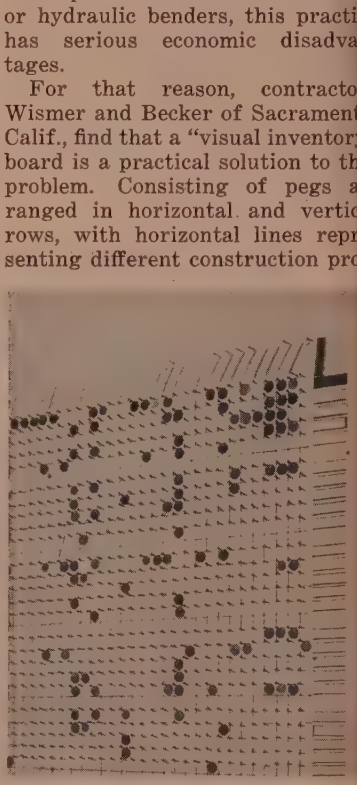
Co. of Bowman, N. D., made the installation.

Broadway has a width of more than 100 ft at Main Avenue and narrows to 54 ft at Northern Pacific Avenue. Due to the variation in street width, the light intensity also varies. The initial lighting was 5.84 footcandles, and is 3.97 footcandles average maintained in service.

Visual Inventory For Tool Allocation

When active contracting organizations have scores of coincident jobs-in-progress, it frequently is difficult to keep track of tools and major items of equipment. This can result either in the time-wasting tracing of items in greatest demand, or in the money-wasting "safegaurd" of purchasing additional units which are stocked to insure ready availability when needed. When such investments include purchase of extra devices such as expensive diamond-core drills or hydraulic benders, this practice has serious economic disadvantages.

For that reason, contractors Wismer and Becker of Sacramento, Calif., find that a "visual inventory" board is a practical solution to this problem. Consisting of pegs arranged in horizontal and vertical rows, with horizontal lines representing different construction proj-



WITH JOBS-IN-PROGRESS identified by cards racked in slots at the left side of this tool-inventory board, and with a full listing of tools and other items of equipment recorded on similar cards placed at the top of the board above aligned columns of pegs, it is possible to quickly determine where tools are being stored or used by noting the placement of related perforated brass discs.

AFTER 30 YEARS ON THE JOB . . . Okolite insulation still looks good. This unretouched photograph shows a section of 11.5 Kv power cable recently re-assigned by Duquesne Light Company. Note that the insulation is stil flexible and resilient—workable. Tests made this year show the tensile strength has deteriorated very little remaining more than 33% above the original specification figure.

30-year-old Okonite cable still tests above specification figures . .

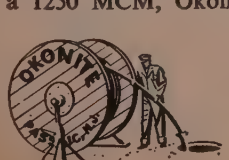
This is CABLE'BILITY *a new word for your vocabulary*

Cable'bility (cā'ble·bil'·i·ty) *new word. Noun.* **1.** Ability to design and manufacture electrical cables that give outstanding performance. **2.** Having long background and wide experience in cable research and application. **3.** Possessing keen understanding of customers' problems. Implies eagerness to serve faithfully and dedication to progress. **Syn.** The Okonite Company.

This is Okonite Cable'bility at work. It's "Old Faithful"—a 1250 MCM, Okolite-insulated power cable made in 1929, now carrying on a new career as a mine power feede for Duquesne Light of Pittsburgh.

"Old Faithful" began service as an 11.5 Kv lead from switchyard to transformer, handling 15,000 KVA loads During World War II, it saw fifteen years of full load oper ation, 24 hours a day. Then in 1957 it was replaced with a larger cable to handle even greater loads. But it wa found still suitable for demanding tasks as a power feeder

There are Okonite "Old Faithfuls" in use today in every application . . . *yours* too. Because, as in 1929, Okonite still produces the most dependable cables on the market The reason is Cable'bility. The Okonite Company, Sub sidiary of Kennecott Copper Corporation, Passaic, N. J



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ects and with vertical rows representing different tools or items of equipment, it is possible to instantly note where tools are being used by observing pegs upon which performance brass discs have been hung. Or, if spare tools are available in the shop stockroom, discs will be noted on the top row of pegs, arranged beneath their related tool-identifying tabs.

Besides serving as a 2-way check for tools on jobs and tools in the shop, this board is also useful in cases where a foreman on a project request use of a unique or major item of equipment, of which there might be only one-of-that-kind owned by the company. In that case, a glance at the inventory board would show where the tool is currently being used; a phone call would promptly ascertain whether the tool could be temporarily spared, and a pick-up truck would be dispatched to quickly make the job-site switch. Of course, the brass tag identifying the article would be simultaneously shifted on the shop inventory board to another horizontal row, thereby keeping the existing allocation status up-to-the-minute in accuracy.

Cross Channels House Lighting Ballasts

To serve expanding administrative requirements of a booming schoolage population, a spacious U-shaped educational center has recently been completed in Fontana, Calif. With three distinct areas designed for superintendent, business and educational services, the structure features a luminous environment designed by lighting consultant Foster K. Sampson of Los Angeles and architect Herman I. Ruhnau of Riverside.

Installed by Copperbar Electric of Baldwin Park, the indirect lighting system primarily utilizes pendant-suspended Sunbeam Sightline P132s in tandem, with ballasts contained in cross-channels spaced 8 ft apart. Mounted 2 ft below 10½-ft acoustically tiled ceiling, the fixture pattern achieves a clean, open appearance. And, with white-enameled components and plastic diffusing members blending with the overhead, brightness ratios are minimized while visual comfort is promoted.

According to contractor Jim Wilson of Copperbar, installation time was greatly reduced due to pre-assembly and pre-wiring of units, inasmuch as jobsite assignments then consisted only of positioning pendants, snapping spring-loaded self-leveling components into place and connecting circuit leads.

The color motif throughout the structure, suggested by prevalent earth and rock tones in the surrounding area, combines brown, beige, yellow and orange, while architectural features of the building consistently reflect clean simplicity of modern planning.

Lobby and main entrance, located in the superintendent's wing, are accented by 4-ft-square semi-recessed fixtures having dropped translucent patterned Plexiglas diffusers, while the president's office and Board Room are illuminated to a maximum intensity of 60 ft by dimmer-regulated luminous-ceiling installations.

ADMINISTRATIVE HEADQUARTERS for unified school district is illuminated to intensities of 45- to 60-fc through general utilization of Sightline fixtures installed in variety of patterns. Area shown above, with fixture rows coupled with ballast-holding cross-channels, obtain 45-fc of diffused light from pendant fixtures.

CAN BE SURE...IF IT'S Westinghouse

Contractor installs
new electrical system
without interrupting vital hotel services

COVER PHOTO: In lobby of Hotel LaFayette, Little Rock, Arkansas, plans for modernization of air conditioning and electrical system are discussed informally by R. R. Erwin, Manager, WESCO, Little Rock; Rawland E. Blaylock, President, Blaylock and Associates, Consulting Engineers; Charles E. Deitz, Chief Electrical Engineer, Blaylock and Associates; Joseph Matthew, Manager, Hotel LaFayette; Ellis Fagan, President, Fagan Electric Company, Inc., and Fagan Air Conditioning Company, Inc.; and H. K. Brewer, Westinghouse Sales Engineer.
J-94126-2

Westinghouse central air conditioning helps hotel Build Business Electrically

Room occupancy increased 21% during the first month after the Hotel LaFayette, Little Rock, Arkansas, installed a new central air conditioning system. The new air conditioning was made possible by a complete modernization of the hotel's electrical system—using Westinghouse equipment.

The decision to install a centralized air conditioning system, built around two 75-ton Westinghouse compressors, meant a large increase in power requirements. The 34-year-old, 700-amp rating system of the 11-story hotel was already overloaded. To meet the new requirements, as well as anticipated needs during the next 10 years, it was decided to modernize the electrical system and increase its capacity to a 3000-amp rating. "Installation of the new electrical system without interruption of the hotel's vital services was the real problem we encountered in this project," stated John A. Bigbee, General Construction Superintendent of the Fagan Electric Company. "The inadequate and unreliable old electrical system was completely overloaded at the main point of distribution, but we managed to utilize the old switchboard cabinet as a junction box to maintain service during the installation."

Westinghouse equipment, including a building-type switchboard of 3000-amp capacity, a class 11-3 motor control center, and Westinghouse Life-Lin low-impedance bus duct, was specified in the custo designed installation. Owner, consulting engine general contractor, electrical contractor, Westi house distributor and Westinghouse engineers work as a team to design the system and specify equ ment which would combine to help the hotel Bu Business Electrically.

Space requirements and equipment accessibility the basement area were unusually tight. Dimensio tolerances were held to 1/16 in. Westinghouse engine resolved this by having the switchboard delivered three parts. The motor control center was shipped two parts. This enabled the electrical contractor bring equipment into the building easily on t hotel's service elevator. Use of Westinghouse equ ment throughout permitted custom fitting to spec cations, yet every component is standard. This ma the installation considerably easier than if varie brands of equipment had been used.

(con

YOU CAN BE SURE...IF IT'S Westinghous

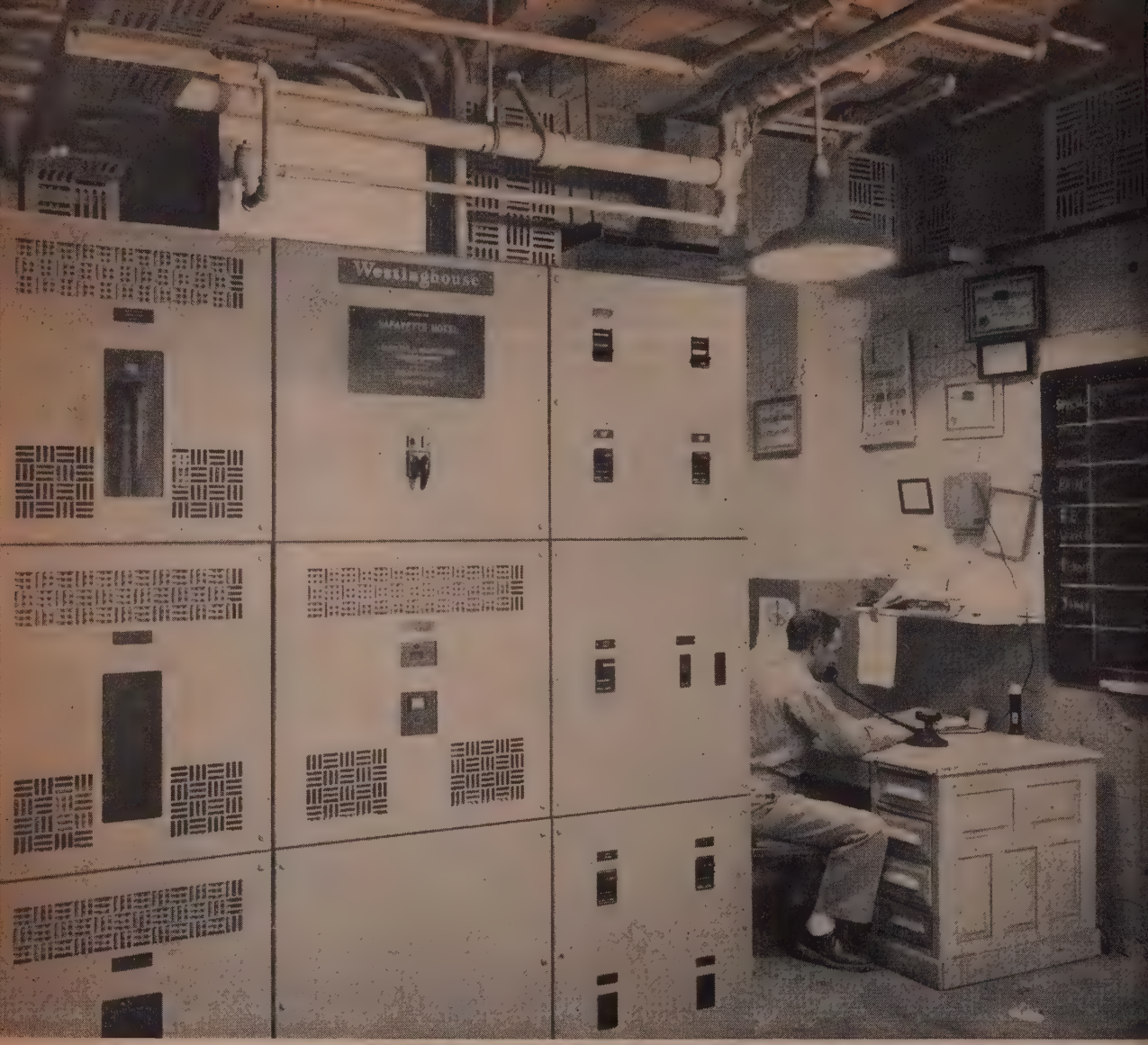
Improved exterior appearance of Hotel LaFayette has resulted from removal of unit air conditioners used on first six floors.

Interior has been brightened by removal of window-type unit conditioners a use of below-window cooling system. New system, made possible with Westi house compressors and Westinghouse electrical modernization, is quieter a more comfortable.

R. L. White, hotel maintenance man, takes reading at one of the two 75-ton Westinghouse packaged water chilling units which are the heart of the new central air conditioning system. These operate in conjunction with three cooling towers on the hotel roof. The two compressors, with low speed and low noise level, are ideal for hotel installations or others where long life and low noise level are desirable.

Paul Gossage, Chief Engineer of the Hotel LaFayette, inspects new Westinghouse motor control center. The unit has two NEMA Size 4 combination linestarters for the compressor motors and 10 smaller combination linestarters for controlling cooling tower fans, exhaust fans and water pumps. Combining all motor starters in one structure allows for one centralized control point, eases maintenance and enhances appearance of equipment rooms.

J-94126-3



Paul Gossage, at desk near new Westinghouse distribution switchboard. Ventilated, low-impedance bus duct is used for service entrance and feeder to the motor control center. Westinghouse Type DB breakers are used for main and heavier feeder circuits while AB De-ion® breakers are used for lighting loads.

Air conditioning made possible by electrical modernization *(contd.)*

Successful contractors have found that selection of all-Westinghouse equipment, plus localized service, greatly increases installation efficiency. Westinghouse can help you with any phase of your electrical planning and construction. Ask the Westinghouse distribution outlet nearest you, or write Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania. J-94126-4

OWNER: LaFayette Hotel Company, Little Rock, Ark.
CONSULTING ENGINEER: Blaylock and Associates, Little Rock, Ark.
GENERAL CONTRACTOR: Fagan Air Conditioning Company, Inc., Little Rock, Ark.
ELECTRICAL CONTRACTOR: Fagan Electric Company, Inc., Little Rock, Ark.
WESTINGHOUSE DISTRIBUTOR: Westinghouse Electric Supply Company, Little Rock, Ark.

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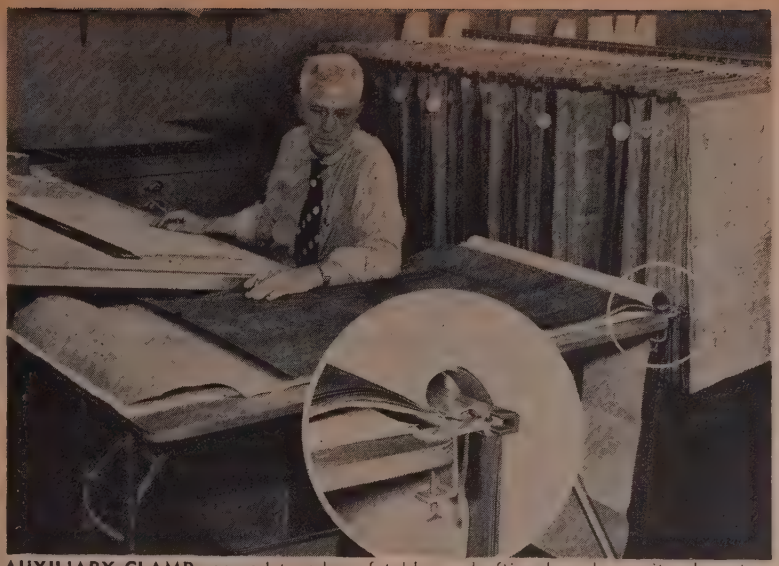


AUXILIARY CLAMP secured to edge of table or drafting board permits plans to be held securely and flipped freely for reference purposes without having them slip or slide, as is often the case. Insertion or removal of prints is easy operation.

New Print Clip Is Practical Filing Aid

In the new office-shop plant of electrical contractors Wismer & Becker of Sacramento, Calif., one finds numerous practical methods and devices in use, including a new design for a print clip. Featuring a ball-and-socket clamp developed by Plan-Hold of South Gate, Calif., the clips securely hold groups of blueprints without the necessity of punching holes or stapling them together. A simple wingnut loosens and opens the ball-and-socket joint for convenient filing or removal of prints.

PLAN-HOLD clamp features ball-and-socket joint that may be tightened or loosened by action of wingnut and yoke collar. Capacity of clip is from 1 to 100 sheets. Parts are of rounded-corner satin-aluminum construction.

Jaws of the clamp open wide enough to hold as many as a hundred sheets, yet close tightly and closely enough to firmly grasp even a single print. Parts are constructed of satin-finish aluminum with rounded edges for convenient handling, while plastic tips provide safeguards against scratching or marring of office furniture.

As indicated by accompanying photos, accessory hangers slip over, lock or detach easily from rack suspension bars, while prints may also be secured to the edge of a table or drafting board for convenient reference.

SUSPENSION CLIP can be secured to or detached from horizontal rack bar by tilting blueprint collar channel vertically. When holding prints in storage, collars are cantilevered and kept vertical by brace secured to wall of office.

Photos Tell Shipping Story

Photography is playing an increasingly important role in expediting shipment and delivery of switchgear to customers of S & C Electric Company, Chicago. Before outgoing shipments are released,

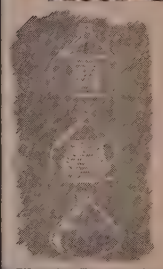
QUAD REFLECTORS

QUALITY INCANDESCENT REFLECTORS FOR 37 YEARS

INDUSTRIAL LIGHTING

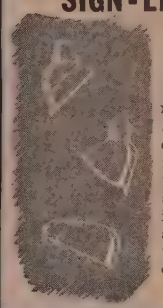
Quadrangle offers America's most complete line of RLM reflectors as well as many other type reflectors. There is a wide range of sizes and a large variety of socket fittings. Many utilize the Quad exclusive Easy-Tach disconnect socket.

FLOOD-LIGHTING



Quad floodlights incorporate design and manufacturing features that are the result of years of research and engineering. There are five different types and more than one hundred and twenty different unit designs to choose from.

SIGN-LIGHTING



There are more than 15 Quad sign reflectors, in a multitude of shapes and sizes, to accommodate lamps from 60 to 1500 watts. There is a size and design for illuminating the smallest signs to the largest outdoor display bulletins.

All Quad Reflectors are rust-proof, weatherproof, finished lustrous porcelain enamel. Available with Easy-Tach or Quick-Detachable horizontal, vertical, feed-through or box-type easy-to-wire sockets.

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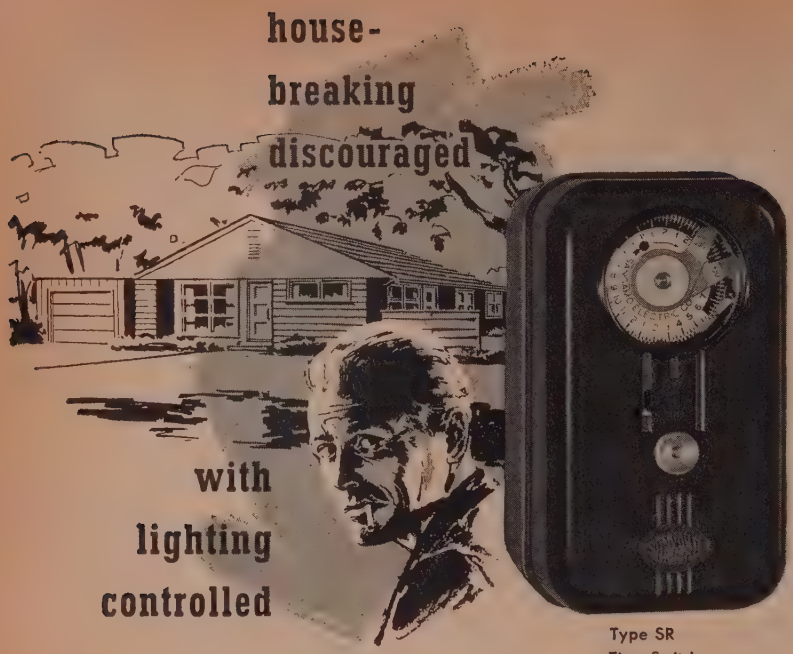


Type SR
Time Switch

BY SANGAMO TIME SWITCHES

Simple jobs, like lighting a vacationing family's house to discourage prowlers, or seeing to it that attic fans or air conditioning units operate automatically, are all in a day's work for Sangamo Types SJ and SR Time Switches.

When you have jobs like these, you do them simply and economically with these small, sturdy switches that can serve in virtually any single-pole, single-throw application. Customers are pleased because the switches are attractive and reliable. You don't make expensive call backs.

The Type SR Switch is designed for indoor installations, either surface mounted or on standard switch boxes with conventional wiring connections. The Type SJ Switch has a built-in receptacle, and is furnished with a 6-foot plug-in cord for portable use. Both switches are powered by a self-starting, high-torque synchronous motor (available in optional voltage ratings). Their heavy-duty silver contacts last for years.

Type SJ
Time Switch

See your favorite wholesaler who has a complete stock of dependable, maintenance-free, long-lived Sangamo Time Switches that can mean full-profit jobs for you.

SANGAMO ELECTRIC Company

SPRINGFIELD, ILLINOIS

ST60-2

STRAPPING TECHNIQUES for heavy switchgear on flat car are photographed before order leaves factory.

BLOCKING METHODS are recorded on Polaroid film and compared to similar shots taken at delivery siding to determine effectiveness of techniques. All rail car photos are mailed to customer before equipment is delivered.

Polaroid photos of switchgear on rail cars record blocking and strapping methods used to prevent shifting during transit. These photos are mailed to the customer so he will know what to expect when the order rolls onto the siding nearest the plant site. Subsequent comparison with similar photos taken by S&C field engineers at delivery time facilitate continuing research in shipping techniques.

By receiving shipping photos ahead of delivery date, the customer can prearrange his unloading procedure and have the necessary equipment available to move the switchgear from rail car to installation site in the most efficient manner. Quick unloading cuts demurrage charges by releasing the car as early as possible. If the equipment is damaged in transit, these photos can help establish when damage might have occurred so that

claims can be fairly and promptly settled.

Now a standard S&C procedure on all outgoing flat car and boxcar rail shipments, photography was first used two years ago in the S&C shipping department to determine the best methods for blocking heavy switchgear to prevent shifting and falling from flat cars. Now, it is being used also to train new shipping department employees in successful blocking techniques. Shipping is also expedited because railroad inspectors indicate preliminary acceptance of cars based on the use of blocking methods depicted in photos of past shipments of similar equipment.

Fluorescents for Restaurant Floodlighting

Royal Castle Restaurants, a chain of hamburger "drive-ins" with headquarters in Cleveland, Ohio, are lighting driveways and parking areas to three to five footcandles with fluorescent floodlighting luminaires. Each luminaire contains two 72-in. extra-high output lamps and is mounted on a 24-ft-high hinged pole. Each location requires three to six luminaires, depending on plot plan. One luminaire covers an area of 1500 to 2000 sq ft.

This type of floodlighting provides Royal Castle with high utilization of light in the parking areas since there is no upward or backward spill light on adjacent areas. Minimum maintenance and low operating cost are realized by the chain since each dust-tight, weather-tight luminaire consumes only 360 watts.

FLUORESCENT FLOODLIGHTS are used to provide efficient high-level lighting in this outdoor parking lot for a drive-in restaurant.

FOR OUTDOOR DUTY

Don't let the styling of STONCO's new "Award Series" fool you. These a **outdoor** bullets. Solid cast aluminum. Completely weatherproof. "Air-cond tioned" for cooler, cleaner operation. The only truly decorative floodligh designed specifically for any outdoor application.

1 Epoxy-cured finishes stay factory-fresh through severest weather. Resist salt-spray, corrosives.

2 Degree-marked pre-aiming quadrant.

3 Deep-gripping serrated teeth for focus lock-in.

4 Full-circle vented ribs (pat. pend.) — pull a moving, cooling air-stream up through the fixture and out.

5 Big internal heat-dissipating fins.

6 STONCO "Cushion-Seal" — high-temp ature live silicone-rubber weatherseal. P tects in any fixture position, even face-

7 Plenty of grip-space between lamp a shield.

8 Lifetime cast aluminum — with that so heft indoor units just don't have.

A COMPLETE LINE FOR 75W-300W REFLECTOR LAMPS Single or cluster fixtures in 3 distinctive styles, wide range of finishes. For ceilings, walls, under eaves . . . all exteriors requiring a high-degree of architectural and color fidelity.

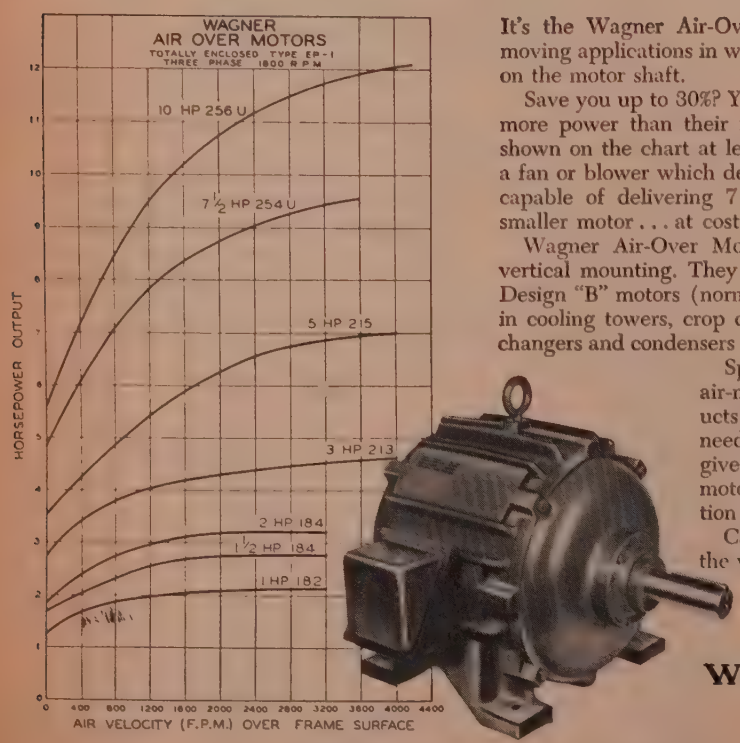
- The Award Series is now on display your STONCO distributor. Look for it.
- Write today for Award Series catal Section A-3.
- See Sweet's Architectural file: 33a/S

STONCO Award Series

CLUSTER LIGHTS
POWER BEAMS
VAPORTIGHT
BOXES and FITTIN
EMERGENCY PORTA

© STONCO ELECTRIC PRODUCTS CO. • KENILWORTH, NEW JERS

This Wagner Motor can save you up to 30% in costs on air-moving equipment



It's the Wagner Air-Over Motor . . . *specifically* designed for air-moving applications in which a propeller or axial flow fan is mounted on the motor shaft.

Save you up to 30%? Yes, for Wagner Air-Over Motors can deliver more power than their rated horsepower output. For example, as shown on the chart at left, a 5 horsepower rated motor installed in a fan or blower which delivers about 4,000 feet of air per minute is capable of delivering 7 horsepower. You get more work from a smaller motor . . . at costs up to 30% less.

Wagner Air-Over Motors are suitable for either horizontal or vertical mounting. They are totally-enclosed, nonventilated NEMA Design "B" motors (normal torque—normal slip). You can use them in cooling towers, crop dryers, exhaust systems, air-cooled heat exchangers and condensers . . . any air-over fan and blower application.

Specify Wagner Air-Over Motors for all your air-moving equipment applications. Your products will operate at peak efficiency for years, need less service and fewer repairs. And, you'll give your customers equipment powered by motors they know . . . motors that have a reputation for long, dependable service.

Call your Wagner Sales Engineer now . . . get the whole Wagner Air-Over Motor story. There are Wagner Branches in 32 principal cities across the country.

Wagner Electric Corporation
6413 Plymouth Ave., St. Louis 33, Mo.

WM60-13

Mechanized Operations Speed Baking and Dipping

Motor repairs are simplified by new equipment in Michigan shop.

THE overall operation-process necessary when dipping and baking batches of small motors or single large motors has been greatly reduced in the shop of the Electric Maintenance and Repair Company in Jackson, Mich. A new 12-ft by 20-ft room completely isolated from the rest of the shop by a sliding garage-size door is the operation center for both dipping and baking processes.

The room contains a large 6-ft deep by 5-ft wide by 8-ft high automatic gas-fired oven, a 4-ft by 4-ft by 4-ft dip tank that is semi-recessed in the room's floor, a ½-ton electrically operated hoist with bridging track running between the dip tank and the oven, a portable shop-made dolly-stand for loading and unloading the oven, a wall-mounted exhaust fan, four ceiling-mounted (temperature operated) fire extinguishers and four 100-watt explosion-proof light fixtures.

The oven, which was formerly used in the production line of a lawn mower manufacturing plant for annealing lawn mower blades, has automatic timer and temperature controls. A blower circulates the oven's heat. The 4-in. insulated double-doors in front of the unit open full to allow access to the oven's interior. A monorail track, centered at the top inside of the oven, holds a ¾-in. by 5-ft steel bar that is fitted with steel hooks. The hooks are used to hold coils and other small parts during their baking process.

Motors placed in the oven for baking rest on a grating formed by 5-ft sections of ½-in. conduit that are welded on 3-in. centers to two 4-ft perpendicular pieces of U-channeling. The pipe-type grating sits on a ⅜-in. by 4-ft by 5-ft steel plate that is mounted on four 3-in. diameter grooved wheels. The wheels of the dolly-type unit ride on two 3-in. inverted angle iron tracks spaced 24 in. apart and welded to the base of the oven's interior.

To unload the oven a 4-ft portable stand constructed of 3-in. angle-iron comes into use. The unit is pushed to the front of the oven until the two 3-in. inverted angle-iron rails welded to its top connect with the two 3-in. inverted angle-iron rails mounted in the oven's interior. The stand is then locked in place by a foot-operated weight-controlled lever installed at the base of the oven. The oven's pipe-type rack with its dolly-frame is then pulled from the oven onto the portable stand, the foot lever holding the stand is released, and the unit is rolled to its desired position in the shop.

For dipping, then baking, the following procedures are followed: The portable stand holding the oven's roll-out dolly-tray is loaded in the shop, then pushed to the bak-

BAKING OVEN has automatic heat and time control, plus roll-out dolly and portable stand for easy loading and unloading. Dolly-tray holding motors rides in and out of oven on angle-iron rails. Foot operated weight controlled lever (arrow) holds stand against oven.

INSIDE VIEW of oven shows dolly supported ½-in. pipe grating, inverted 3-in. angle-iron rails, and monorail holding steel bar or supporting small parts during baking. Notice fit (arrow) between portable-stand-supported rails and the rails mounted to inside base of oven.

SHOP CONSTRUCTED portable stand with 3-in. inverted angle-iron rails that connect to same type of rails mounted in oven provides track for oven's dolly-tray grooved wheels. The dolly-tray is loaded in the shop and then pushed to the baking room's dip tank.

Why be puzzled about time switches?

SPECIFY PARAGON

the 40-amp T-rated switch line

Get the benefits of completely automatic time control

ASTRO DIAL keeps pace with the sun! Time switch can be set to go *ON* at sunset, *OFF* at sunrise . . . or OFF at any other preselected time. Seasonal changes do not require resetting time control. Astro Dial is easy to read . . . easy to set . . . the easiest way to control time.

SPRING-WOUND CARRYOVER keeps time switch operating perfectly despite failures in power. Electrically wound mainspring provides ample reserve running time. Escapement regulates the carryover device. After power is restored, mainspring is wound by synchronous motor which operates the time switch. Specially designed cam and lever prevent spring from overwinding.

Astro Dial and Spring-Wound Carryover are just two of Paragon's exclusive time control features. For further information on these . . . and many others . . . *write for Bulletin 5919.*

ASTRO DIAL

4000 SERIES

PARAGON
ELECTRIC COMPANY
1614 Twelfth St. • Two Rivers, Wisconsin

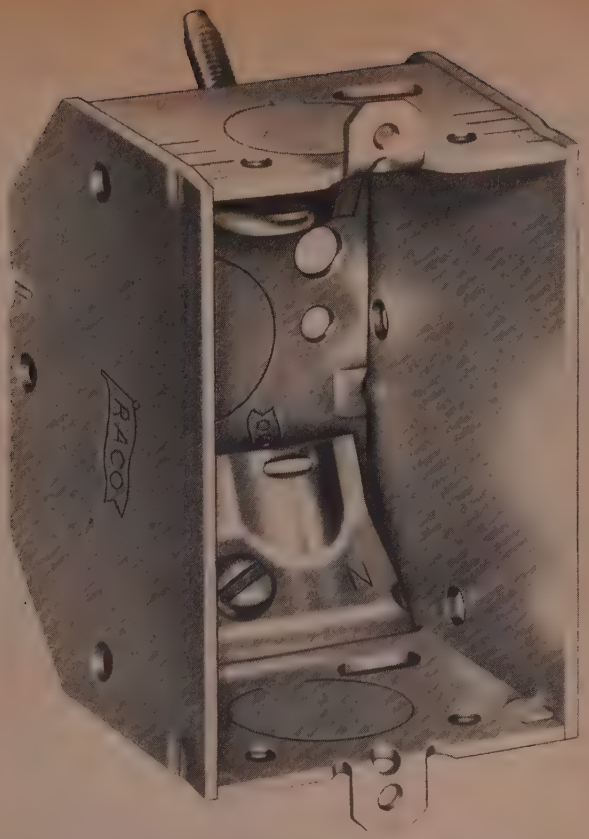
TIME IS MONEY— CONTROL IT WITH PARAGON

SEMI-RECESSED varnish dip tank adj cent to baking oven is constructed ⅛-in. sheet steel reinforced with ang iron. A fusible link release on the d tank's counter weighted cover drops smother flames in case of fire. Not see in photo is ½-ton hoist and bridging be tween dip tank and oven.

ing room's dip tank. A ½-ton elec trically operated hoist lifts the mo tors (one at a time), dips them, an replaces them on the portable-stan supported tray. This process is re peated until all motors have bee dipped. The stand is then pushe to the front of the oven, locked i place and the dolly-frame tray hold ing the motors is pushed from th stand to its position in the over Then, the foot lever is released, th stand is rolled out of the way, th double oven doors are closed, th timing and temperature control are set and baking is started.

The 4-ft by 4-ft by 4-ft varnis dip tank's counterweighted cove floor with about 14 in. extendin above the concrete slab. The uni is constructed of ¼-in. steel rein forced with angle-iron and painte red. A fusible-link release on th dip tank's counterweighted cove drops to smother flames in case o fire.

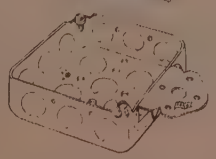
BUSY MANAGER Carl Trowbridge spend his time coordinating the activities o Lenawee Electric Company, Adrian, Mich The firm's operations encompass moto repairs, panelboard construction an assembly and electrical construction work



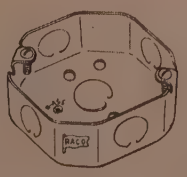
Charlie RACO Says...

There's a real difference in RACO boxes...

RACO's complete line of precision clamps meets every wiring need. The new "Q"* Quick-clamp is a real time saver. Insert cable... it's locked in place. No screws to tighten.



RACO's complete line of brackets gives you just the right bracket for any job. All RACO brackets are projection welded for added strength... rigidity.



RACO's K.O.'s and Pri-Outs are easy to remove... save valuable time on the job.

Your RACO Distributor has the complete RACO line of switch and outlet boxes, covers, bar hangers and set-up boxes. Tell him you want RACO boxes... no other!

*T.M.

RACO **ALL-STEEL EQUIPMENT INC.** AURORA, ILLINOIS

the main characteristic of every Sorgel dry-type transformer is...

QUIET QUALITY

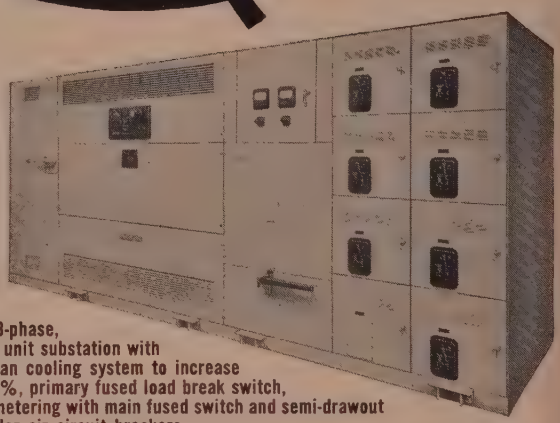
Still setting the industry's pace for lowest sound levels . . . Sorgel's New 1960 Line features additional reductions in size and weight!

A great many independent authorities agree that Sorgel Sound Rated Dry-Type Transformers have historically been the industry's Quiet Quality line. Biggest human reason why: Men with a desire for excellence make Quiet Quality a crusade at Sorgel. Significant results: (1) The industry's lowest sound level. (2) Unexcelled overload capacity. (3) Unequalled operating efficiency. (4) Long range economy. Proof: Certified tests and case history engineering data, furnished upon request, substantiate Sorgel's Quiet Quality performance. Customer benefits: Complete satisfaction and appreciation.

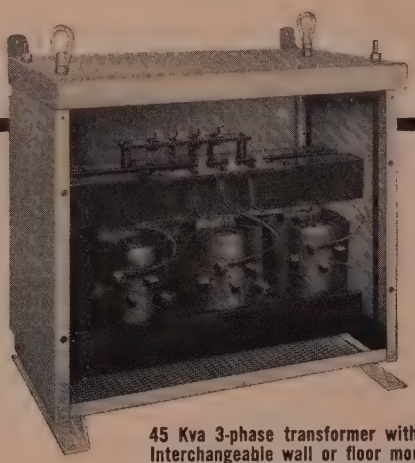
Sorgel also offers these proven advantages:

- **Lower Copper Loss** — *Coils are liberally designed for the most effective use of the latest developments in insulating materials, have large air ducts for low hot spot temperature and are vacuum-impregnated to provide a co-ordinated insulation system.*
- **Lower Core Loss** — *Cores are designed with the industry's lowest magnetic flux densities, resulting in low core loss and the lowest sound level. Entire unit is secured within a substantial frame. Large units are mounted on vibration dampers to minimize vibration transmission to adjacent areas.*
- **Quicker, Easier Installation**—*The enclosure is self-supporting and entrance can be made on sides, top, bottom, or back. Connecting is made easier by means of solderless connectors on terminal blocks in roomy connection compartments. Units up to 75 Kva single phase and 45 Kva 3 phase are furnished for interchangeable wall or floor mounting.*

The same quiet SORGEL transformers are also incorporated in substations. Procurable with any type or make of switchgear, or from any electrical manufacturer. Contact Sorgel today for the Double "Q" in dry-type transformers . . . Quiet Quality.



1500 Kva, 3-phase, 12,000 volt unit substation with automatic fan cooling system to increase capacity 33%, primary fused load break switch, secondary metering with main fused switch and semi-drawout fusible feeder air circuit breakers.



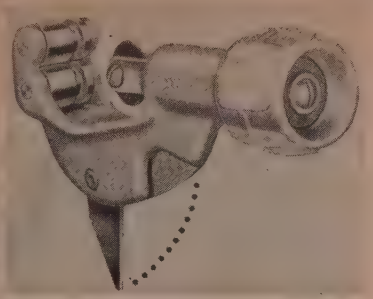
45 Kva 3-phase transformer with taps. Interchangeable wall or floor mounting. Front panel removed, showing interior.

Complete Line for Every Purpose up to 10,000 Kva, up to 15,000 Volts, Including Special Transformers and Saturable Reactors

SORGEL ELECTRIC COMPANY

836 W. NATIONAL AVENUE • MILWAUKEE 4, WISCONSIN

Sales engineers in principal cities. Consult the classified section of your telephone directory or communicate with our factory.



Tubing Cutters (1)

Two new tubing cutters, featuring fully enclosed feed screws have been introduced. Called Ridgid Nos. 105 and 205 tubing cutters, they give clean cuts of copper, brass, aluminum tubing and thin-wall conduit. Each carries a spare cutter wheel in the handle. A special cutter wheel for the No. 205 only is available for cutting plastic and aluminum pipe. No. 105 cutter has a ⅛-in. to 1⅛-in. O.D. capacity and No. 205 a ⅛-in. to 2⅜-in. O.D. capacity.

Ridge Tool Company, Elyria, Ohio

Substations (2)

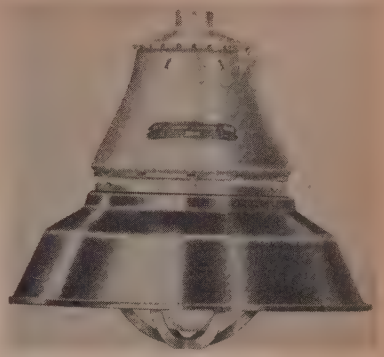
A line of completely coordinated unit substations for supplying power to such loads as industrial plants, commercial buildings, hospitals, and school buildings. Four different transformer types, open and sealed dry-types, 300 kva and above, oil and Pyranol filled, 112½ kva and above, are used in the centers. Open dry-type unit is designed for indoor use. Pyranol filled centers and sealed dry-types may be used for indoor and outdoor applications in dusty, dirty, or contaminated atmospheres. Oil-filled units can be installed outdoors in any location, or indoors in a fireproof vault. The integral distribution centers incorporate an incoming cable termination compartment or high voltage switch, a transforming section, and a low voltage section containing breakers or feeders to meet the requirements of all light to medium power load applications. Sizes through 2500 kva are available provided breaker interrupting capacities are not exceeded and the number of breakers does not exceed the physical size of the low voltage compartment. The center transforms primary voltages (2400-15,000 volts) down to utilization voltages of 480Y/277, 480 delta, 240 delta, or 208Y/120 volts.

General Electric Co., Schenectady 5, N. Y.

Switchboard (3)

The VFS modular distribution switchboard will meet all operating requirements up through 5000 amps, with quick-make, quick-break switch action. Using QMQB switches for applications up to 1200 amps and SP-1 service protectors for applications up through 500 amps; the VFS switchboards are designed especially for use in medium and large commercial, institutional and industrial buildings where service needs range from 600 through 5000 amps, 250 and 600 volts. With modular design, switches can be added, replaced or interchanged. Supporting the switch units and connecting them to the bus are specially designed phenolic insulators which are capable of handling short-circuit stresses up to 100,000 amps.

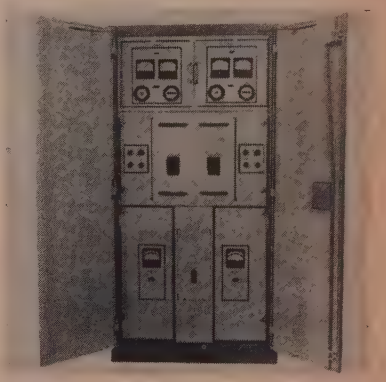
Federal Pacific Electric Co., 50 Paris St., Newark 1, N. J.



Lighting Fixture (4)

Large 1- and 1¼-in. size hubs are on all pendant type explosion-proof and vaportight lighting fixtures. The "AA-51" explosion-proof lighting fixtures, available in both mercury-vapor and incandescent, are vented and meet UL requirements for Class I, Groups C and D, hazardous location, and Class II, Groups F and G, hazardous dust location. Literature is available.

Appleton Electric Co., 1701 W. Wellington Ave., Chicago 13, Ill.

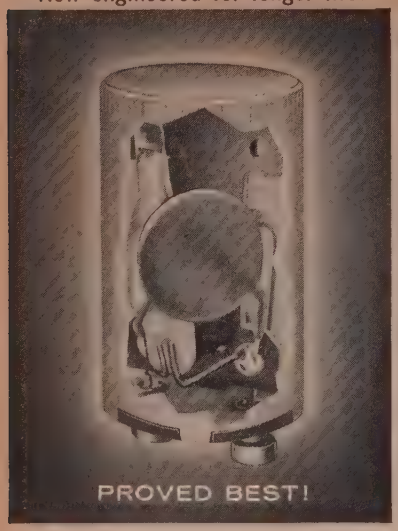


Control Systems (5)

New "packaged" control systems use compatible modules to provide from 1 to 34 industrial control functions. The line is particularly intended for use with motors, generators and alternators, as well as with heating, air conditioning, power conversion, or chemical processing equipment. Seven basic "Standard combinations" are provided for the most popular motor-generator and motor-alternator sets, and a total of 27 options are provided in each class. The line is available for both commercial and military applications. Bulletin CS-5919 is available.

Regulators, Incorporated, 455 West Main St., Wyckoff, N. J.

Now engineered for longer life!



Sylvania cuts starter failures by 98%!

What's the secret? Every Sylvania starter has a *ceramic* condenser! Other starters have paper condensers. Heat, cold, moisture knock 'em out. But not Sylvania starters!

HERE'S PROOF! In a two-year test in one manufacturing plant (installations were two-lamp, 40-watt industrial type fixtures), Sylvania fluorescent starters had

only 1 failure out of 340 starters

Conventional starters with paper condensers had

51 failures out of 330 starters

No wonder Sylvania can sell the only starters with an *exclusive* Light Insurance Policy. *Guaranteed* performance, or your money back! It's your assurance of lowest TCL (Total Cost of Lighting), which means cost of lamp plus power plus maintenance.

This is Sylvania research at work for you—consistently in the lead in lighting! For all types of starters, call your Sylvania representative, or write:

Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept. 15, 60 Boston Street, Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., P. O. Box 1190, Station "O," Montreal 9.

SYLVANIA

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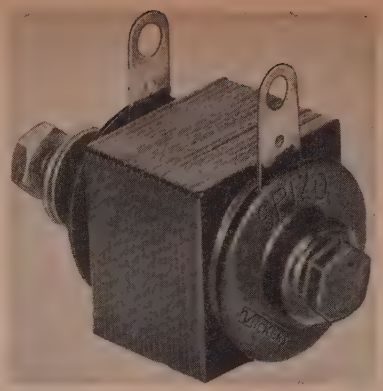
GENERAL TELEPHONE & ELECTRONICS



Surge Protector (6)

Type SP surge protectors protect silicon power rectifiers from breakdown due to transient high voltage. Non-linear resistance, decreasing with increase in voltage, plus built-in capacitance, absorbs intermittent surge energy up to 3000 watts, limiting voltage to safe value for silicon rectifier. Nine standard types cover the range of 50 to 600 volts normal p.i.v. rating.

Electric Products Div., Vicker Incorporated, 1815 *Locust St., St. Louis* 3, *Mo.*

Panelboard (7)

A new NALP circuit breaker panelboard provides distribution of electric power for commercial, large residential and light industrial power applications. Designed to be used with Stab-lok circuit breakers, NALP distribution panelboard protects lighting and power circuits with ratings up to 600-amp main bus and 100-amp branch circuits. Using the entire range of Stab-lok circuit breakers from 15 through 100 amps, 1-, 2- and 3-pole, the panelboard offers expanded flexibility in circuit layout; circuits can be added, subtracted, or substituted by stabbing in the breakers. Double bus arrangement of panelboard permits breakers to be mounted in any location regardless of frame size. Since breakers feature modular construction, 2- or 3-pole breakers can be substituted for any two or three single-pole devices. Literature is available.

Federal Pacific Electric Co., 50 *Paris St., Newark* 1, *N. J.*

Lights (8)

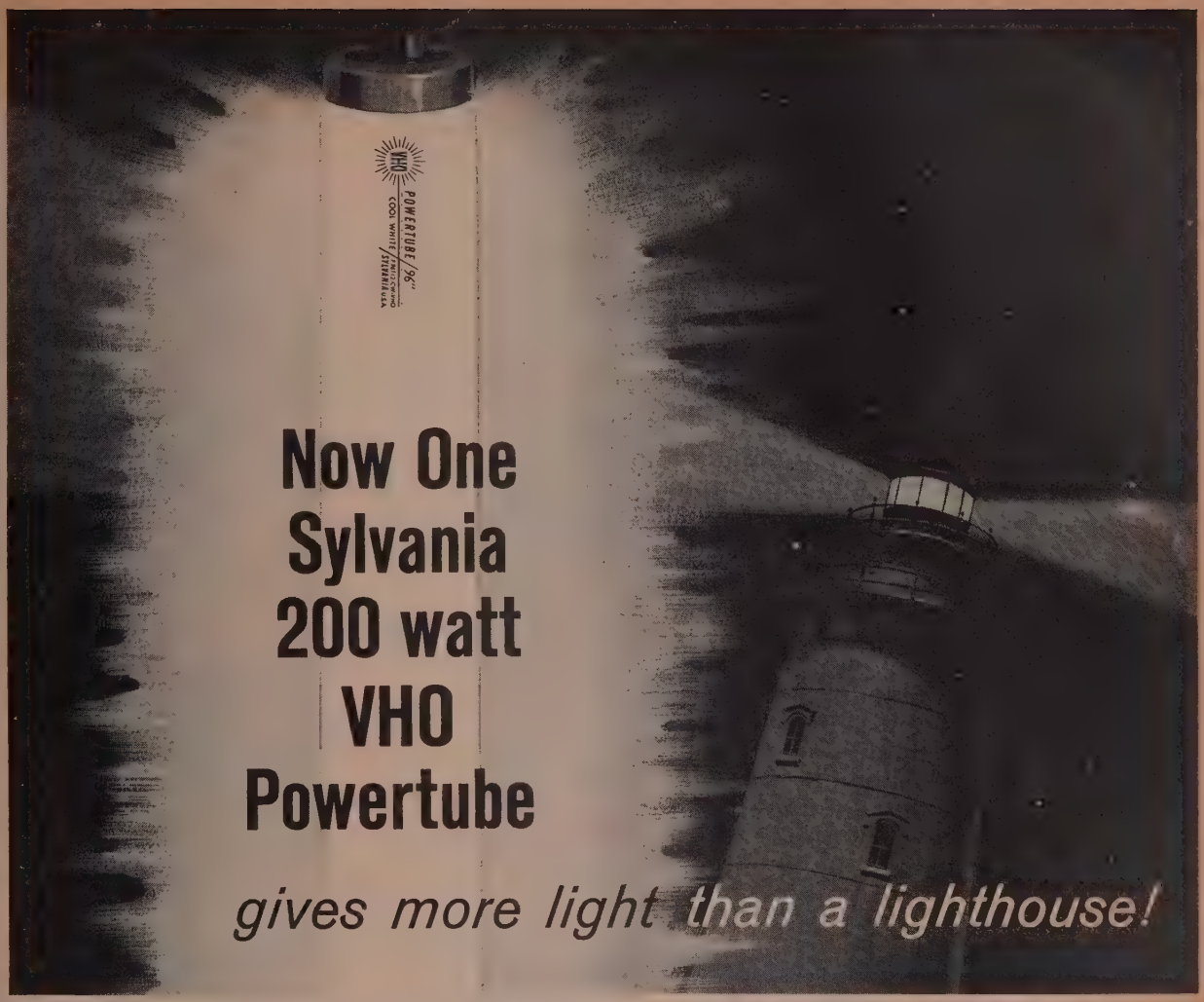
A new medium intensity airport runway marker light, Model 2 Type ERL, with a spring mounted tilting cone. A sheet steel spring allows cone to tip slightly, instead of breaking off, under stress. Model 2 ERL fixture with clear or green globe is normally used on non-instrument runways, and has several styles of mounting bases. With blue symmetric globe it is used for standard taxi light locations, such as intersections, corners and short taxiways. An asymmetric blue globe, which provides two main beams, is available for long straight taxi strips.

Crouse-Hinds Company, Syracuse 1, *N. Y.*

Receptacles (9)

A new, interchangeable line of TV flush receptacles, caps and wall plates are designed to improve the appearance of TV installations. The one-gang, two-unit receptacle provides for UHF and VHF connections. One-gang units may incorporate interchangeable grounding receptacles with one TV outlet. Combinations of power and TV units must incorporate single or two-gang divider plates. Receptacles which fit all standard outlet boxes are available in brown or ivorylite. Plates are Uniline bakelite, brass or stainless steel.

Arrow-Hart & Hegeman Electric Co., Hartford, Conn.

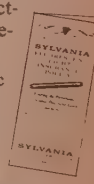


Many lighthouses don't deliver as much light as this *one* 8-foot Sylvania VHO Powertube. 15,000 lumens! Smooth, white, and no glare!

It's not surprising that more and more companies use Sylvania VHO (Very High Output) Powertubes in all sizes —indoors and out! Only Sylvania Powertubes give you all this:

- **2½ times more light** than you get from standard fluorescent lamps of the same size.
- **Smooth tubular surface** doesn't catch or hold dust.
- **Less weight, easier to handle.** Powertubes weigh *half* as much as other shapes, no "heavy" fixtures needed.
- **Slimmer size.** T-12 1½" tube diameter means better air circulation around tube than larger diameter lamps.
- **Uniform light distribution.** Sylvania VHO Powertubes deliver full light output in any position.
- **Better optical control.** You get full use of light because it can be *directed* exactly where you want.
- **Lowest TCL—total cost of lighting**—means lowest cost of lamp plus power plus maintenance.
- **Exclusive Light Insurance Policy.** Sylvania lamps are *guaranteed* to perform better in your opinion than the brand you are now using . . . or your money back!

EXTRA! INSTALLATION SERVICE. Sylvania engineers have also developed a more effective mounting system *and* directional control for fluorescent lamps. Called CFR (Controlled Fluorescent Reflectance), it brings greater efficiency, light reflectance from VHO Powertubes. Ask your Sylvania representative. Call him, or write us:



Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept 15, 60 Boston Street, Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., P.O. Box 1190, Station "O," Montreal 9

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS** GENERAL SYSTEM

POUR CONCRETE To Very TOP

Still Have PLENTY ROOM to WORK

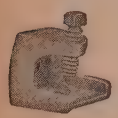
The #190 "Tru-Level" steel-bodied, brass-topped adjustable floor box permits pouring of concrete to very top in one operation—Or, to box-body height only, for which a second tin lid is provided.

After concrete is hardened, a full ½" horizontal adjustment is possible.

The box-body has a 3¼" opening—plenty large enough to get hand into for conduit attachment or wire-pulling.

A skin tight plastic collar seals out moisture while protecting adjusting-ring threads. No voids or water pocket can occur with plastic ring fitting tight against surrounding concrete and remaining there.

Listed under re-examination service of Underwriters Laboratories, Inc.



Insulator Supports

Fasten porcelain or glass insulators to steel framework without punching holes. 4 sizes—1", 1½", 2" and 2½".

Latrobe Products

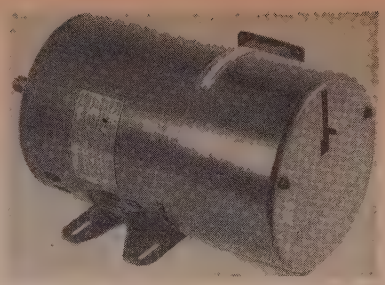
Non-Adjustable Floor Boxes
Adjustable Floor Boxes
Gang Boxes—Cover Plates
Junction Boxes—Nozzles
Pipe or Conduit Hangers
Insulator Supports
Cable Supports—Fish Wire
Staple and Cable Clips

Sales Representatives in all principal Cities

Booth #516
52nd N A E D Convention
Dallas, May 1-4

FULLMAN MANUFACTURING CO. QUALITY AT LATROBE SUPREMACY LATROBE, PA.

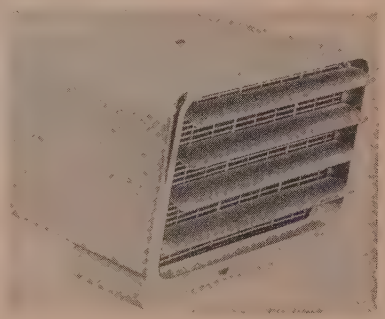
Fullman
MANUFACTURING COMPANY
1209-1215 JEFFERSON ST.
LATROBE, PENNSYLVANIA



Brake Motors (10)

A newly designed line of Form G fhp, 3-phase, ac brake motors in dripproof and totally enclosed, fan-cooled construction, feature unified design which makes motor and brake an integral, one-piece unit. Magnetic brake is used to bring motor to rest and to hold load stationary when motor is not energized. It is spring-set and solenoid-released, and will automatically set in event of power failure. Brake torque is 3 lb-ft continuous. When brake is de-energized, springs apply brake. Brake coil windings are single phase. They are available in sizes ranging from ½ through ¾ hp. All models are rated 208-220/240, 550 volts, 1725/1425 rpm.

General Electric Co., Schenectady 5, N. Y.



Heater (11)

New electric unit heaters, designated as UH-Series, are for use in offices, reception rooms and stores. They are constructed for continuous heavy-duty use, featuring ⅝-in. stainless-steel sheath type heating elements which are totally enclosed and non-glowing. It has a factory prewired, built-in 30-amp contactor. A thermal safety cut-out provides protection against overheating due to over-voltage, motor failure, etc. A manual reset to prevent on-and-off cycling. Chassis-type construction permits entire internal components, including heating elements, contactor and thermal cutout to be removed as a single unit for cleaning or servicing. Heaters are available in 5 kw and 7.5 kw capacities, 208, 240 and 480 volts. They may be wired for either single or 3-phase operation through use of bus bar connections.

Berko Electric Manufacturing Corp., 212-40 Jamaica Ave., Queens Village 28, N. Y.

Enclosures (12)

A series of soft rubber, pendant-type pushbutton enclosures, No. 4000 Series, are oil-proof, moisture and oil tight, impervious to oil, grease and most chemicals. The "Safety Yellow" No. 4000 Series is available in nine models to accommodate all standard oil-tight push-button units, indicator lights and selector switches. Each model comes with sealing grip, suspension bracket, and internal grounding strip. Brochure is available.

Daniel Woodhead Co., 15 North Jefferson St., Chicago 6, Ill.

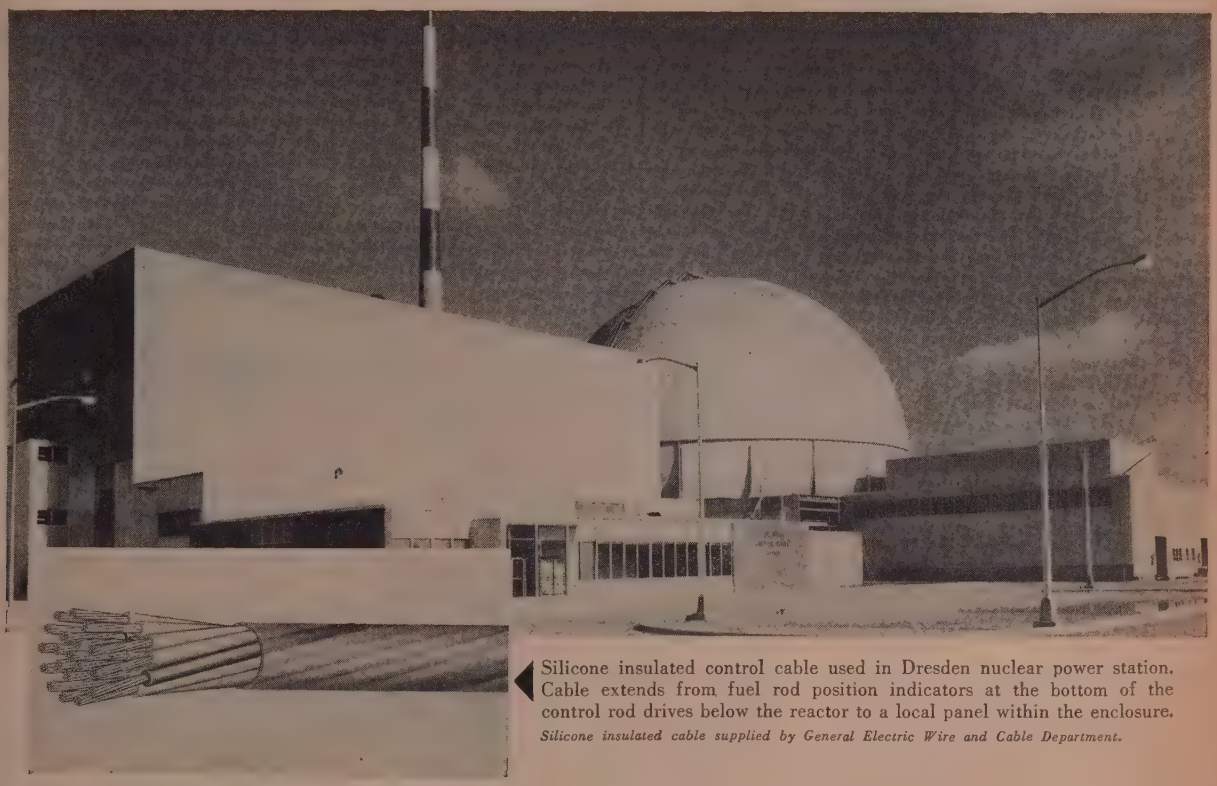
Regulator (13)

A transistorized voltage regulator designed for use on constant-speed alternators rated to 480 volts, 50-60 cycles. It may be used with alternators either singly or in parallel service. Regulator includes an ON-OFF switch, voltage-adjusting rheostat, cross current resistor for 3-phase units, and a potential transformer for voltages to 480 volts. The Autostatic is also available to order for single phase 400 cycle, and for dc applications. Several primary taps on the potential transformer allow regulator to be used for 120-, 208-, 240- and 480-volt service. Secondary current from potential transformer is rectified and filtered before it reaches control transistor. Available in three models; A-50 kw, B-200 kw, and C-350 kw; the Autostatic regulator unit can handle up to 3.4-amp exciter shunt field current. Mountings include semi-flush or chassis.

Lake Shore Electric Corp., 500 Willis St., Bedford, Ohio

General Electric Silicone Rubber Insulation chosen for Dresden Nuclear Power Station

Excellent moisture and heat resistance, protection against gamma radiation



Silicone insulated control cable used in Dresden nuclear power station. Cable extends from fuel rod position indicators at the bottom of the control rod drives below the reactor to a local panel within the enclosure.

Silicone insulated cable supplied by General Electric Wire and Cable Department.

Because it combines many desirable properties, particularly a combination of heat and radiation resistance, General Electric silicone rubber insulation is being specified for control and power cable in atomic reactors and other nuclear power generation equipment.

G-E silicone rubber also provides a more reliable and efficient cable insulation for many other electric utility and industrial applications. Among its many advantages are the following:

Excellent Heat Resistance: In power cable applications, offers long service life at temperatures up to 150°C; overload temperatures to 225°C; short-circuit overload temperatures even higher.

Extra Current-Carrying Capacity: As a result of its excellent heat resistance, cable insulated with G-E silicone rubber can carry up to twice the current as can conventional cable of the same size.

Low Moisture Absorption: Easily withstands moist operating conditions that may cause other insulations to fail.

High Ozone Resistance: Ozone and corona, which cause rapid aging of organic rubber, have negligible effect on silicone rubber.

Low Temperature Flexibility: Class 900 electrical grade G-E silicone rubber stays flexible at temperatures down to −60°C, special grades to −100°C.

Radiation Resistance: G-E silicone rubber insulation will withstand gamma radiation up to 1×10^8 roentgens, about 20 times higher than fluorine-containing insulation.

For more facts and figures on G-E silicone rubber insulation, write General Electric Company, Silicone Products Department, Section DD1213, Waterford, New York.

GENERAL ELECTRIC

SILICONE PRODUCTS DEPARTMENT

Section DD413, Silicone Products Department
General Electric Company, Waterford, New York

Please send me further data on silicone rubber cable insulation.

Name_____ **Title**_____

Company_____

Address_____

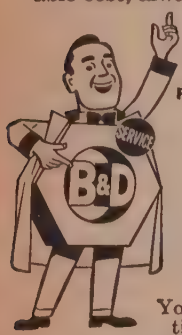
City_____ **Zone**_____ **State**_____

. . . and for

NEARBY SERVICE on Black & Decker tools.

Black & Decker maintains 50 factory service branches plus authorized service stations to give your B&D tools the attention mechanical products need periodically. Keep your B&D tools in top condition, on the job all the time.

Only factory parts and factory-approved methods are used. Fast service and reasonable cost, always.



SWIFTY SERVICE says be sure to ask about:

FREE TOOL INSPECTION no cost, no obligation.

STANDARD B&D GUARANTEE after completion of all recommended repair work.

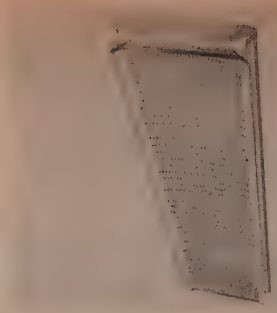
You'll find the location of the nearest B&D repair facility in the Yellow Pages under "Tools-Electric," or write for address to: THE BLACK & DECKER MFG. CO., Dept. 1204-S, Towson 4, Md.

50th YEAR

See Tools-Electric -Yellow Pages-for Service & Sales

Black & Decker

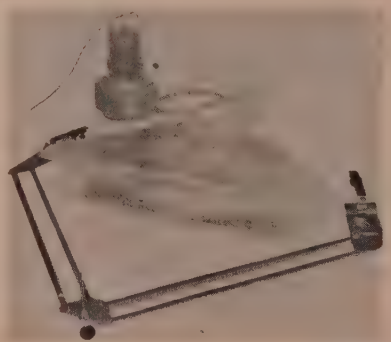
Quality Tool Service



Lighting Fixture (14)

A new Sculpturama series has been designed with Holophane Prismalume acrylic lens panel. Prismalume is a single, inwardly curved 1- by 4-ft acrylic lens panel with reinforcing prismatic crosswise ribs. The framed panel may be opened from either side. It is a shallow, surface-mounted unit.

Sunbeam Lighting Co., 777 E. 14th Place, Los Angeles 21, Calif.



Indicator (15)

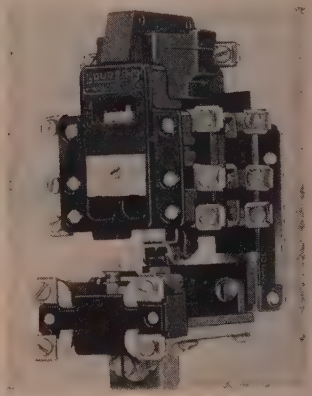
The No. 1807 pipe bending degree indicator fits any hydraulic pipe and conduit bender operating in a horizontal position. Scale indicates degree of bend on any ½-in. to 6-in. diameter pipe. On-the-job figuring is eliminated, and pipe need not be removed to determine the degree of bend.

Greenlee Tool Company, Rockford, Ill.

Locator (16)

A new device, called Code Cover, serves as both a protector and locator of electrical outlets for plastered walls. It is a metal plate which is snapped onto outlet box before plastering; a protective tape is then peeled off the plate exposing a small tablet of dye set into a cavity in the plate. Plate fits flush with box cover so that it offers no interference with plastering. A small spot of color from dye tablet bleeds through plaster and spotlights exact location of outlet. When plaster is dry, pressure is applied to dye spot; and outlet opening and screw plate is then removed and discarded. It is adaptable for gang cover and sectional switch boxes.

Code Cover Company, 566 N. Pine, Chicago, Ill.



Relay-Timer (17)

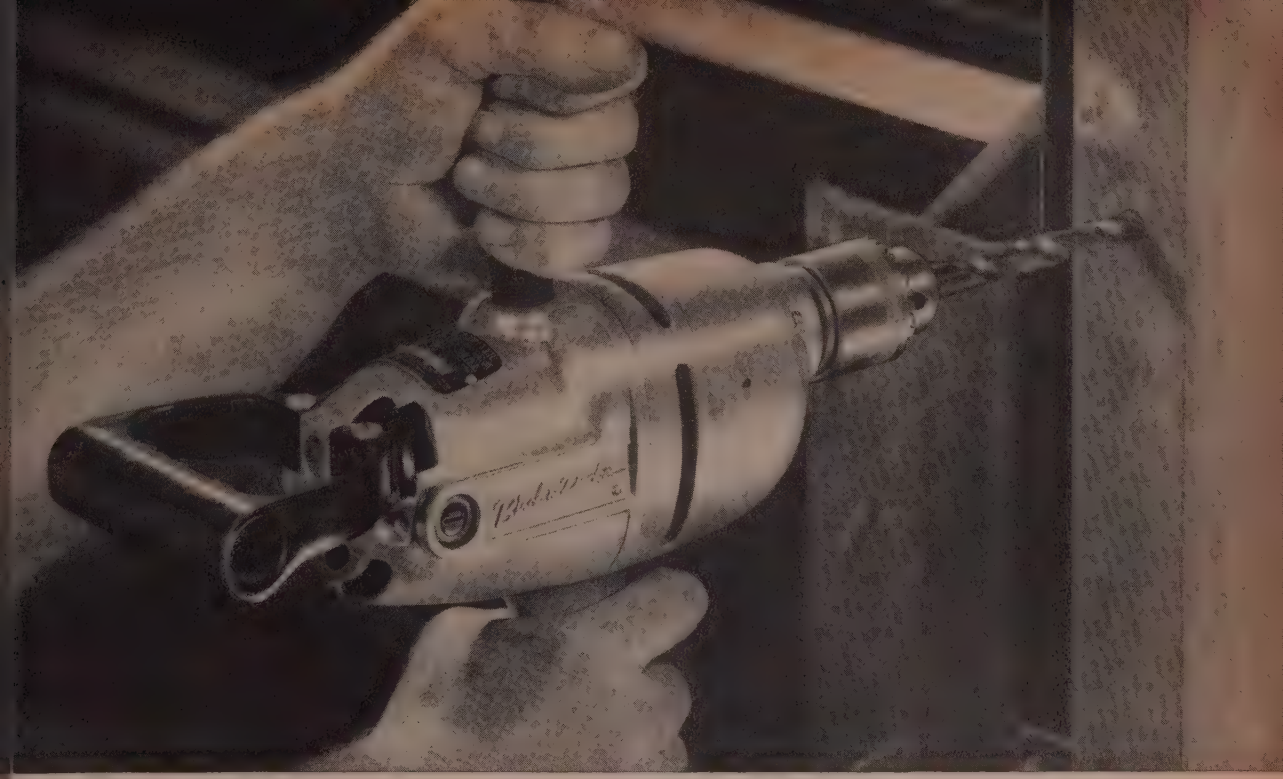
A new device which combines the functions of a machine tool relay with a time-delay relay has been announced. The new relay, which has mounting dimensions identical to all Square D Type D relays and Type A timers, reduces panel mounting space and installation time. Timer head provides either time delay after energization or time delay after de-energization, and is convertible in the field from one to the other. Timing range is from 0.2 second to 1 minute, plus or minus 15%. Relay is available with 2 NO and 2 NC or 4 NO and 2 NC instantaneous contacts, plus 1 NO and 1 NC timed contacts. Relay contacts are rated at 10 amps. Pressure wire connectors are supplied on all terminals.

Square D Company, 4041 North Richards St., Milwaukee 12, Wis.

Adhesive (18)

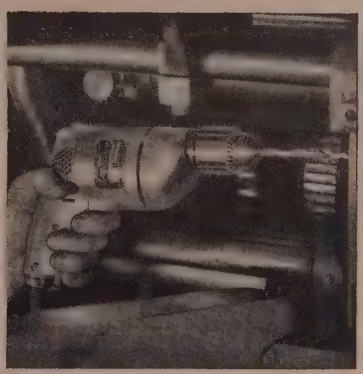
PA-1041 Epoxy resin junction box mount for adhering electrical junction boxes to masonry walls, ceilings and floors, metal beams and wood surfaces has been developed. It is a 2-part (epoxy resin-hardener) material packaged in a separator type cup which is the mixing container. Junction box mount is waterproof, weatherproof, resistant to acids, alkalies, solvent-free, non-toxic and non-dermatitic. Each cup unit will do eight to ten 4-in. by 4-in. junction boxes.

Permacel, New Brunswick, N. J.



Light in your hands, tough on the job!

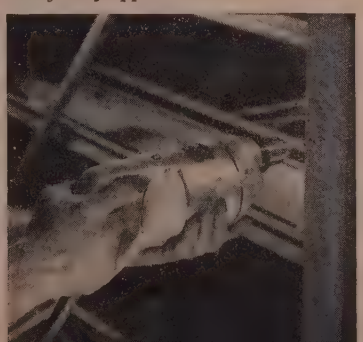
MOST POWERFUL DRILL of its size available, the Black & Decker ¾" Standard. Powered to pull a locomotive with full power in reverse; positive drive chuck.



TREMENDOUS TORQUE developed by this ⅜" H.D. Holgun® takes on the tough ones with ease. Compact to work in tight quarters, this tool's a "best buy."

DRILLS UPSIDE DOWN! B&D Magnetic Drill Presses stick like glue in any position; operate manually or with exclusive remote control. 1¼" or ¾" capacities.

POWER NEARLY DOUBLED in B&D ¼", 5/16" and ⅜" End Handle Drills gives you more performance for the price . . . better control for heavy-duty applications.



Make those heavy drilling jobs go quicker, easier . . . with the lightweight Black & Decker ½" Special Drill. Its precision-balance, compactness and years-ahead design make handling easier yet. And, of course, famous B&D rugged construction proves itself right through any job.

No matter if you're drilling a small hole in trim or a large hole in structural steel . . . you can find the drill you need, from ¼" thru 1¼", in the line preferred throughout industry—Black & Decker. You always get the best motors, the finest construction, the newest features (such as, full power in reverse). Why not see the complete line?

Leading Distributors Everywhere Sell

50th YEAR **Black & Decker**

QUALITY POWER TOOLS

MAIL COUPON FOR FREE DEMONSTRATION

THE BLACK & DECKER MFG. CO., Dept. 1204
Towson 4, Md. (In Canada: Brockville, Ont.)

☐ Please arrange for a demonstration of the following drill(s).....

☐ Please send me additional information on .....

Look Under "TOOLS-ELECTRIC" in Yellow Pages

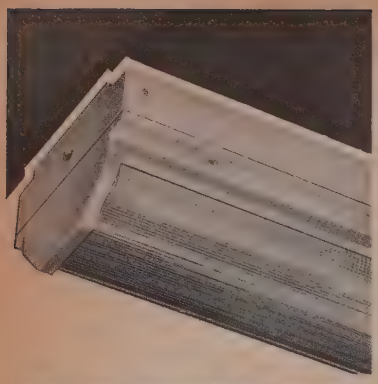
Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

☐ Impact Wrenches ☐ Hammers ☐ Belt Sanders ☐ Vacuum Cleaners



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98
line
weatherproof
fluorescent

extruded aluminum
enclosed and gasketed
waterproof • corrosion resistant

For tunnels - underpasses - airport ramps subways - loading docks - station terminals laboratories - chemical industries - garages piers - service stations - swimming pools and marine applications.

High corrosion resistance combined with strength . . . low brightness with Holophane compound Controlens® . . . new wiring economy with extra large wire channels . . . Choice of High Output Rapid Start or Slim line - available in 4, 6, 8 ft. individual lengths or in continuous runs.

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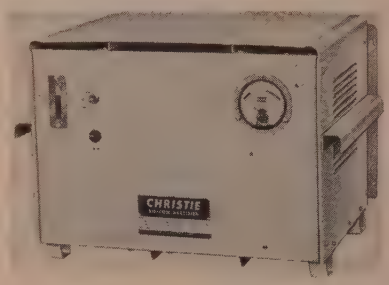
LIGHTING
1329 Willoughby Ave., Brooklyn 37, N. Y.
In Canada: mcPhilben division of Wakefield Lighting Ltd. London, Ontario

your McPhilben representative has a 98 Line sample unit . . . ask to see it.
Sweet's 33a/Mc

Bender (19)

A new line of conduit benders, known as Appleton-Benfield benders, are for hand bending electrical metallic tubing, rigid steel and rigid aluminum conduit. One model bends all three standard types of conduit. Some of the features are —outriggers on hook to stabilize tool and give operator solid footing; extended foot treadle or "Powr-Jack" booster step; degree scale; bold symbols on each side of tool; and made of unbreakable alloy malleable iron.

Appleton Electric Co., 1701-1759 *Wellington Ave., Chicago* 13, *Ill.*



Battery Chargers (20)

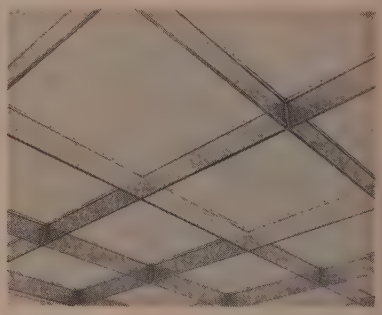
A complete line of automatic battery chargers for lead acid, nickel cadmium, silver zinc, silver cadmium and Edison batteries. All units employ Silicon power rectifiers; and Silicon diodes are used in the control circuit. The standard line includes models ranging from 6 to 120 volts, 0-125 amps output. Close end voltage regulation, plus or minus 1%, is maintained for a change in ac line voltage of plus or minus 10%. Moving coil type dc voltmeter and ammeter are standard on each machine.

Christie Electric Corp., 3410 *West 67th St., Los Angeles, Calif.*

Fish Tape (21)

A new flexible round fish tape for jobs using aluminum conduit has been introduced. Called "Flexi-Strand," it is made of preformed galvanized aircraft cable. It has no sharp edges to gouge or cut into soft conduit. It withstands up to 1500 lbs pull and is equipped with an extra large eye to accommodate the following wires: 20 No. 14, 15 No. 12, 10 No. 10, 4 No. 8 and 3 No. 6. "Flexi-Strand" tapes are available in three models—reel type, handle type and plain.

Ideal Industries, Inc., 1041 *Park Avenue, Sycamore, Ill.*



Lighting (22)

New Sigma III is a slim-downed version of the original Sigma multifunction ceiling. The ceiling combines comfortable lighting with noise absorption and provides a grid for support of the new thin-wall movable partitions. Air diffusion is through louvers. Access to grid, which supports the vertical posts of movable walls, is provided at intersection of acoustical baffles. High levels of illumination are maintained with comfort by utilizing the louvering effect of the acoustical baffles and by the 45° by 45° shielding of steel framed louvers.

The Wakefield Company, Vermilion, Ohio

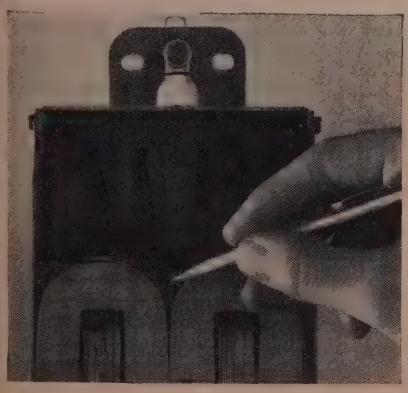
Cable Cutter (23)

A new armored cable cutting tool, called "B-Xer," cuts cable from 14/2 up to 10/3. Recessed high speed hack saw blade permits armor cutting without damage to wires or insulation. Cutter is made of aluminum. It may be used in close places, such as inside of boxes.

Dunham Tool Co., Inc., Electrical Div., P. O. Box No. 52, *New Fairfield, Conn.*

NEW POTTED INDUSTRIAL TRANSFORMER STOPS MOISTURE DEAD!

LONGER USEFUL LIFE WITH 100% COIL AND CORE SEALING... IMPROVES PERFORMANCE, ELIMINATES MAINTENANCE OF WESTINGHOUSE UNIT



Westinghouse developed a silica-filled resin compound for completely encapsulating the core and coils of this industrial transformer. The unit is absolutely impervious to moisture and water-laden industrial atmospheres.

This compact, lightweight transformer is easy to mount . . . can be mounted in *any* position. Attractive appearance and low noise level permit installation of unit *anywhere* without objection. No transformer hum to distract workers.

All Westinghouse "EP" transformers bear the UL label. Available in ¼-, ½-, ¾-, 1-, 1½- and 2-kva ratings at 600 volts and below for lighting, small motor loads and the like. For larger load applications, "EP" single-phase units are rated 3 to 10 kva, 5000 volts and below for *indoor* service . . . 3- to 15-kva transformers, 600 volts and below for indoor-outdoor installations. Also available in 3, 6, 9 and 15 kva, 600 volts and below, three phase for indoor-outdoor applications.

Units also available in ratings for auto and buck-boost applications.

Convenient stocks of the Westinghouse "EP" dry-type transformer are stocked throughout the U.S. Contact your Westinghouse sales engineer for complete data on the "EP" line or write Westinghouse Electric Corporation, P.O. Box 231, Greenville, Pennsylvania. J-70938-R

YOU CAN BE SURE...IF IT'S Westinghouse

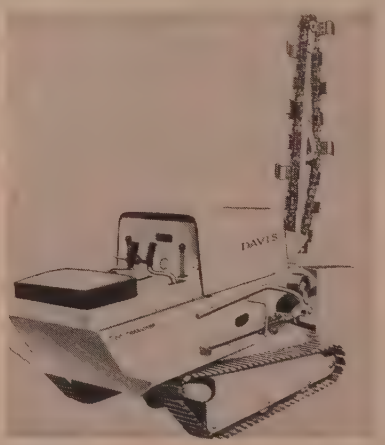
WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV ALTERNATE FRIDAYS

"More or Less"
THE BEST
DITCH WITCH
TRENCHER
Other trenchers cost "More or Less"
Other trenchers dig "More or Less"
BUT DITCH WITCH PRODUCES MORE TRENCH FOR LESS MONEY
Model M-322 Pictured
TRENCH SIZES FOR 4 MODELS:
16" 12" 10" 8" 6" 4" 3"
K-1 30 HP
M-322 12 HP
M3 9 HP
C-3 7 HP
1' 2' 3' 4' 5' 6'
Trenching Speeds 1½ to 12 FPM
USE FOR:
• Utility Services
• Gathering Lines
• Signal Lines
• Sewer Laterals
• Road Crossings
• Sprinklers
• Footings, etc.
CHARLES Machine Works, Inc.
626 Birch St. • Perry, Okla.
To Locate Distributor, Look Under "Contractors Equipment" in 1960 Metropolitan Telephone Directory Yellow Pages for Ditch Witch Trademark; or Call Collect FE 6-4404, Perry, Okla.

Luminaire (24)

A new luminaire with a plastic refractor is for use in rural or suburban lighting. The Acrylic-Suburban unit is constructed with a built-in ballast for up to 250-watt mercury vapor lamps or without ballast for up to 6000-lumen filament lamps. Unaffected by corrosive atmosphere, refractor resists thermal shock and is interchangeable with glass refractors of similar design. Different refractor designs give IES Type II, Type II 4-way, and Type V light distribution patterns. All units have a locking type receptacle so they can be used with the cadmium-sulphide photoelectric control for automatic dusk-to-dawn lighting.

General Electric Co., Schenectady 5, N. Y.



Trencher (25)

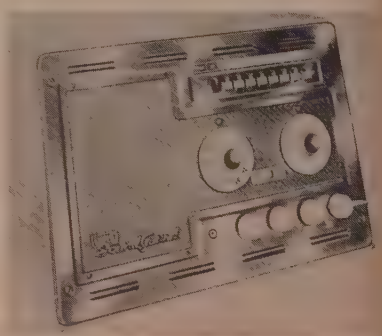
A new crawler-type trencher and backfill machine, the Davis T-66, features positive traction, hydraulic variable speed drive, instant forward and reverse, and control of complete trenching and backfilling operation. It digs 3 to 4 in. wide down to 66 in. deep; or 12 in. wide, 30 in. deep, and at varying widths and depths in between. Positive traction is obtained by use of tracks instead of pneumatic tires. Propulsion is obtained by a hydraulically-driven, two-speed gear reduction which transmits power to positive-acting drive clutch. Trenching speed is from 1 to 12 ft per minute.

Davis Mfg. Inc., 1500 So. McLean Blvd., Wichita 13, Kans.

Switch (26)

New photo electric cover plate switches by Protect-O-Lite automatically turn lights on at dusk and off at dawn. Time delay, up to three minutes, prevents lights from being turned off by momentary flash of light such as car lights or flashlights. Totally-enclosed switch with cover plate fits standard outlet boxes for operating incandescent, fluorescent, neon or mercury vapor lighting fixtures. Rating is 10 amps, 115 volts ac, 400 watts incandescent, 1000 watts fluorescent or mercury vapor. Two models are available: 2¾ in. by 4½ in. rectangular and 4 in. round cover plate switches.

Energy Kontrols, Inc., Geneva, Ill.

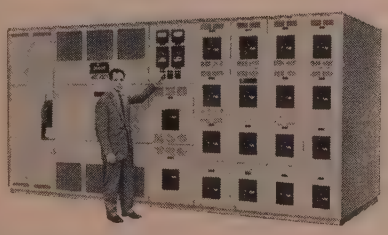


Intercoms (27)

The Sound-Guard "Convertible" radio intercoms may be used in the older home or apartment without cutting holes, or fishing wires through walls. Master station and remote speakers fit in cabinets of beige leatherette. Cabinets will accommodate any one of four Sound-Guard systems: Commander, deluxe model with AM-FM radio and phono input jack; Sentinel, with clock-controlled AM radio and timed appliance outlet; Guardsman, for full fidelity AM radio; Cadet, budget-priced intercom with AM radio and components. Units can be converted to "built-in." They are for room-to-room conversation, music throughout home and outdoors, monitor nursery or sickroom, identification of callers at door.

Progress Manufacturing Co., Philadelphia 34, Pa.

"But I was positive we didn't need another substation!"



MORAL: For good voltage regulation and better operating efficiency, put a secondary unit substation in each load area. And for complete information on today's most value-packed line of substations, write for Bulletin 3104-1A, I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton Street, Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

ROLLING SCAFFOLDS

by PS CO.

raise efficiency
lower costs . . .

When maintenance or repair goes above arm's reach, you can **control costs** with PS CO. Rolling Scaffolds . . . all bearing U.L. Label.

steel —"Trouble Saver" Rolling Scaffolds are erected from simple, easy-to-assemble parts. End frames, 2', 3' or 5' wide, are joined by pivoted diagonal braces to form the basic unit. Additional frames are placed on top of the original basic unit by means of sprockets.

or aluminum — Sectional Scaffolds are erected from separate frames, braces, and stairways. Base dimensions are 4'6" x 6'. 29"—or 4' 6" Wide Sectional Ladder Scaffolds available in 6', 8' or 10' spans with ladders 4', 5'4" and 6'7" high. "Fold-A-Way" Scaffolds go up without acrobatics, flip-flops. Base unit 7' high, sections 6'. Base—4'6" x 6'.

Write for Bulletin G-205RR

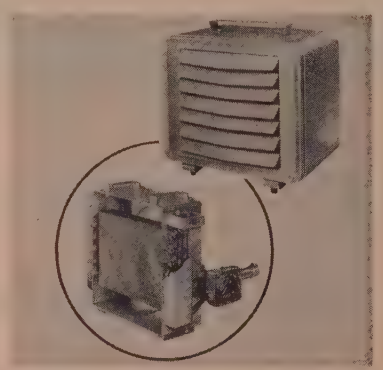
THE PATENT SCAFFOLDING CO., Inc.

38-21 - 12th Street, Dept. ECM.
Long Island City 1, N. Y.
1550 Dayton St., Chicago 22, Ill.
West Coast: 6931 Stanford Ave., Los Angeles 1, Calif.
Branches in all Principal Cities

Transformer (28)

A newly designed dry type transformer for industrial and commercial service, with noise levels below NEMA requirements. Single and 3-phase units in ratings through 15 kva and 600 volts are designed with core and coil assemblies in steel weatherproof cases completely filled with a new ERS compound. The compound filling results in rapid transfer of heat and quiet operation. A roomy terminal compartment with knockouts in sides and bottom is provided. Descriptive bulletin S-202-C is available.

Standard Transformer Company, Warren, Ohio



Heaters (29)

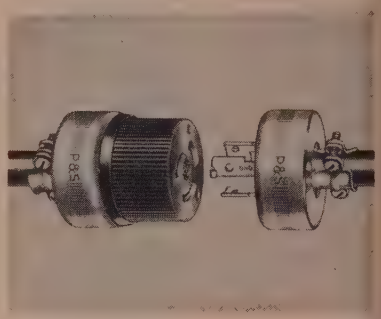
A stainless steel finned sheath heating element is the heart of the new line of heavy duty electric fan-forced unit heaters for industrial and commercial use. The capacities of this line of unit Heetaires, Series 600, range from 2 kw to 10 kw with 208, 240, 480 and 575 volts in single and 3-phase types, with either built-in or remote thermostat controls. Units are designed to be either suspended from ceiling, or wall, or used as portables. They are UL and CSA approved.

Markel Electric Products, Inc., Buffalo, N. Y.

Motors (30)

Three new standard models have been added to this line of series-wound universal motors. Open continuous ratings are: ½ hp at 5,000 rpm; ¾ hp at 7,500 rpm; and 1 hp at 10,000 rpm. All three are built in frame size 4334, have pad type bases. Standard motors, built in aluminum housings, operate on 115 volts dc to 60 cycles ac and are non-reversible, rotating counter-clockwise at commutator end.

Universal Motor Div., Robbins & Myers, Inc., Springfield, Ohio



Cord Grip Cap (31)

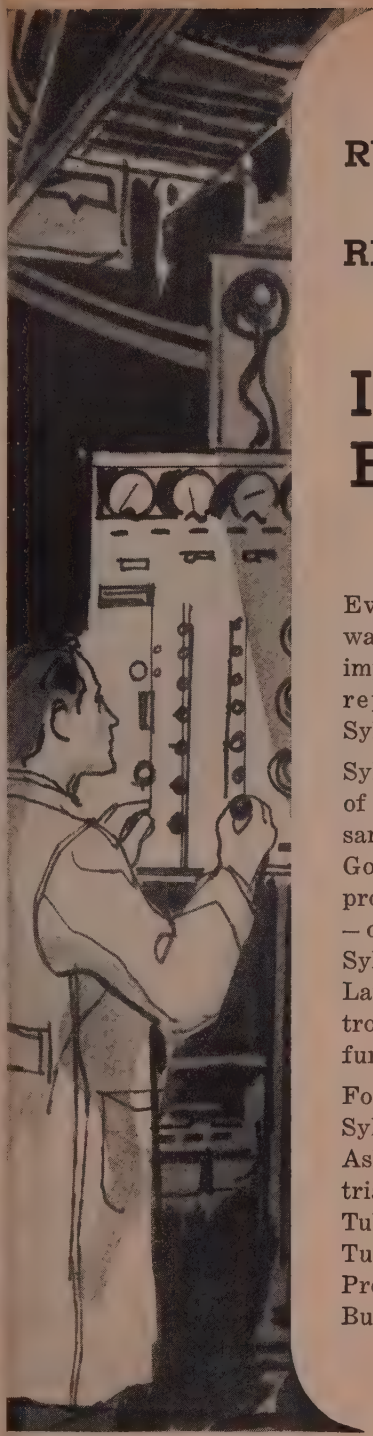
Turnlok 3-wire cord grip cap, No. 7311, and Turnlok cord grip connector body, No. 7313, are particularly suited for industrial applications. Connector body is constructed with plastic, heavy armor and positive contacts. Armored section of body and cord grips is finished to resist corrosion. They are rated at 20 amps, 250 volts, ac or dc and 10 amps, 600 volts ac.

Pass and Seymour, Inc., Syracuse 9, N. Y.

Time Switch (32)

The new 70-amp "Badger" time switch is "T" rated. Dura-treated, plunger action copper contacts are UL listed for all types of loads, including tungsten lamps. Pressure type terminals for wire sizes 14-4 are integral with contact assembly. Switch is supplied with heavy-duty timing motor suitable for either indoor or outdoor use. Switch may be operated manually without interfering with subsequent automatic operations. Cabinets are NEMA standard, either flush or surface mounting, fitted with hinged covers and provided with 14 combination knockouts to accommodate various wire sizes up to full rated load.

Automatic Lighting Co., Racine, Wis.



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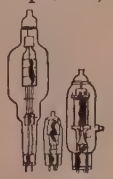
RELIABLE,
READILY AVAILABLE...

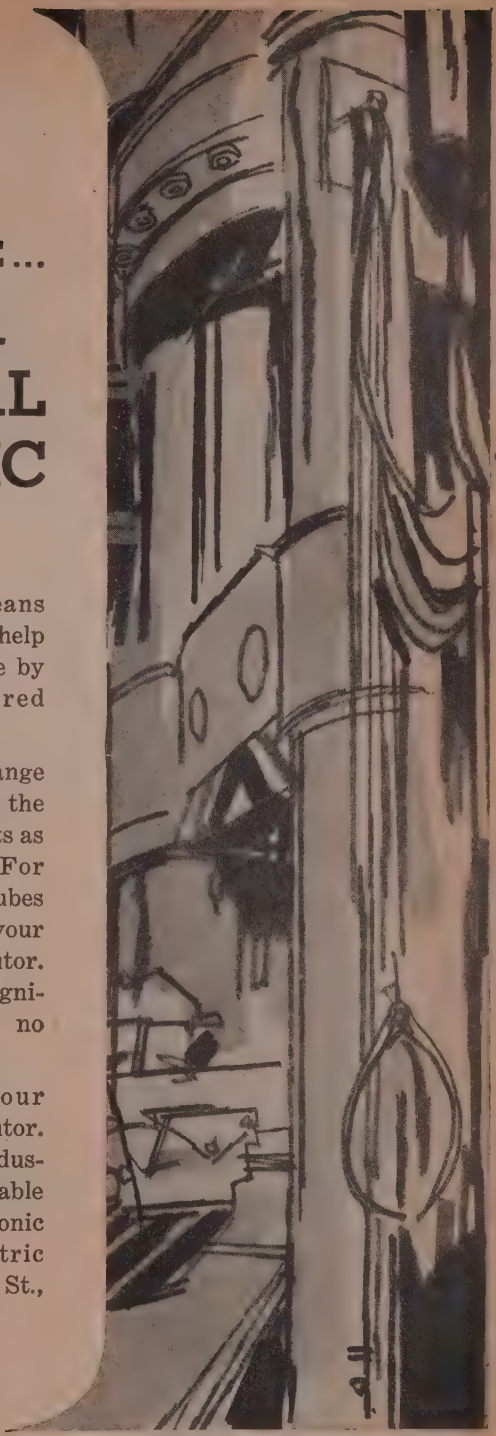
SYLVANIA INDUSTRIAL ELECTRONIC TUBES

Every hour of "downtime" means wasted production time. You can help improve reliability and cut waste by replacing with quality-assured Sylvania Industrial Tubes.

Sylvania manufactures a wide range of Industrial Tubes produced in the same tradition for reliable products as Gold Brand premium tubes. For prompt delivery of Industrial Tubes – often same-day service – see your Sylvania Industrial Tube Distributor. Large and small power tubes, ignitrons, thyratrons, rectifiers are no further away than your phone.

For more information see your Sylvania Industrial Tube Distributor. Ask him for the new "Sylvania Industrial Tubes" and "Gold Brand Reliable Tubes" booklets, or write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. 154, 1100 Main St., Buffalo, N. Y.





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Subsidiary of GENERAL TELEPHONE & ELECTRONICS

The Best Way To Install Boxes & Fixtures In Dropped Ceiling Work . . .

Arrow Conduit

CHANNEL SUPPORT

MORE ECONOMICAL!

MORE EFFICIENT!

No more makeshift arrangements! These features are "selling" contractors, everywhere!

- Many slots allow fixture stud to be attached anywhere on support
- Special design in this support assures maximum strength and rigidity for supporting fixtures
- Two sizes: 1" wide by ½" deep; 1½" wide by ¾" deep
- Made in 10 ft. lengths. Can be cut in multiples of 6"
- 14 gauge galvanized steel.

Samples and specification sheets on request.

OUTLET BOXES • GANG BOXES • COVERS • BOX SUPPORTS

ARROW CONDUIT & FITTINGS CORP.

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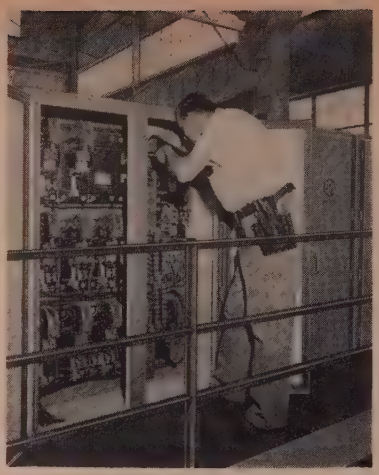
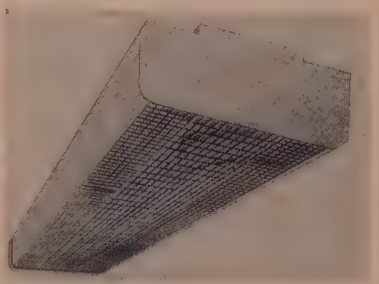


Control (33)

New front-connected controllers which eliminate the need for back aisle space on crane walkways. Control components are mounted on insulated bases which in turn are mounted on panel studs projecting from rear of cabinet. Furnished with 2, 3 or 4 decks to suit headroom requirements, the controllers are available for single-motor dc drives up to 225 hp. Bulletin 6121 is available.

Square D Company, EC&M Division, 4500 Lee Road, Cleveland 28, Ohio



Fluorescent Fixture (34)

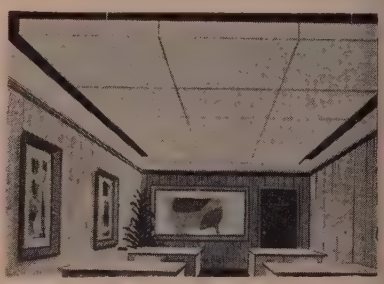
A new shallow fluorescent fixture, called HI-LO, is 3⅝ in. deep, including diffuser. The one-piece wrap-around plastic shielding lowers from either side for lamp maintenance. For continuous runs, end plates are removed so that plastic to plastic run provides an unbroken stream of diffused light. When pendant mounted, the wrap-around diffuser provides a dustproof encasement that permits uplighting through the plastic as well as emitting light through sides and bottom. Soft, modified lighting is given off, when surface mounted.

Metalcraft Products Co., Inc., 6225 State Road, Philadelphia 35, Pa.

Aluminum Pole (35)

An Alrectic lattice pole, 85 ft long and 2 ft sq, withstands hurricane forces. The pole is intended for use on a 69-kv transmission line through congested residential and business areas. Average span will be 600 ft. The pole, complete with three 7-ft crossarms, weighs 1400 lbs. Although the pole does not taper dimensionally from bottom to top, the weight and strength is strategically distributed by using three sizes of chord angles with stiffener plates welded inside the chords.

Line Material Industries, McGraw-Edison Company, Milwaukee 1, Wis.



Lighting Unit (36)

Power-Lite is a pendant type fixture, CIE general diffuse classification, designed to provide high intensity, direct-indirect illumination in a large area. Utilizing new high lumen output 15,000 ma lamps, it provides up to 200 to 450 footcandles at working levels, shielded by 45°-45° aluminum or plastic louvers. Modular in design, units can be joined together end-to-end, side-by-side or in a large area unit of any geometric pattern.

Metalcraft Products Co., Inc., 6225 State Road, Philadelphia 35, Pa.

Auger (37)

The "PolerBore" digs through rock, frost or frozen ground. Special cutting teeth are for boring and drilling through sandstone, hard rocks, concrete, coral, marl and frost; for general purpose digging through clay, earth and gravel; and for rough uneven digging through stony ground, rock knobs and shale. Available in 10- to 36-in. diameter "PolerBore" digs to any depth depending on type of earth-boring machine used and fits any machine.

Trainer Associates, Inc., New Castle, Del.

Strong Reasons

for specifying rigid conduit in STEEL

Proved Strength

Recent comparison tests indicate that Rigid Steel Conduit is up to ten times stronger than rigid conduit made from aluminum. Steel conduit provides these strength advantages:

—300 to 1000 pct *greater resistance to impact,* depending on the magnitude of the impact and the conduit size.

—100 to 250 pct *greater beam strength* at either the full section or the threaded joint, depending on the load and the conduit size.

—150 pct *greater resistance to flattening* from static loads.

Proved Dependability

For over 50 years Rigid Steel Conduit has provided electrical circuit wiring with the most thorough mechanical protection available. *And it still does.* Inexpensive to buy, easy to install, simple to rewire, steel conduit is highly compatible with every construction material in major use.

Get the strongest protection—be sure to specify rigid conduit in steel for your next electrical job. Ask your electrical distributor for full details.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Distributor: Bethlehem Steel Export Corporation*

BETHLEHEM STEEL

BETHLEHEM STEEL

Electric Drill (38)

A new variable-impact electric drill, 18 in. long and weighing 10½ lbs, capable of sinking a ¾ in. hole 3 in. deep in concrete in 180 seconds, has been developed for use in the building trades and maintenance service. The heavy-duty unit handles carbides from ½ to 1⅛ in. The variable-impact force is derived from a spring-loaded hammer cam striking the drill chuck anvil twice on each revolution of the shaft. Drill is powered by a 4-amp heavy-duty motor that operates on 115 volts dc or ac, 60 cycles or less.

Moorhead-Crego, Inc., 645 S. Green Rd., Cleveland 21, Ohio

Trunk Rack (39)

A demountable truck rack, universally adaptable to all pick-up trucks has been developed. Built of heavy steel, rack is quickly installed in the stake holes of the pickup body with an adjustable arm resting on side of the body. Arm is rubber padded to prevent marring.

Wedgelock Corp., 11323 Hartland St., North Hollywood, Calif.

Frame Sizes (40)

An extension in frame sizes to provide a complete line of Kinamatic industrial motors, generators, and motor-generator sets, has been announced. Extension includes four NEMA frame sizes, 584A, 585A, 683A and 684A, and results in 28 new drip-proof motor ratings and 14 new drip-proof generator ratings. Design improvements include integral cast main field coil and pole assembly providing greater protection and improved heat transfer. Easier maintenance is offered since complete pole and coil assembly can be replaced as a single unit. Large or extra large conduit boxes are available for mounting on either side of 58-680 frame Kinamatic motor. Internal wiring is arranged so that leads may be brought out from either side.

General Electric Co., Schenectady 5, N. Y.

Electric Plants (41)

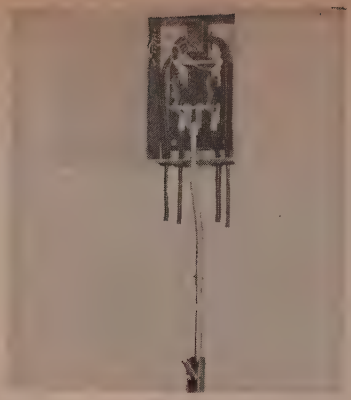
The 1750-, 2000- and 2500-watt electric plants have been redesigned, reducing weight of generators by 25 lbs and increasing hp from 10 to 15%. All three models have, as standard equipment, six receptacles for multiple operation of power tools and other equipment electric start, hi-lo battery charge on all ac models, rpm indicator and cast aluminum skids.

Pacific Mercury, 13232 Leadwell, North Hollywood, Calif.

Bender (42)

Weight of the "Chicago" conduit and pipe benders has been reduced about one-third by redesign and use of high strength steel. Weight reduction, plus a new wheeled stand, makes unit completely portable. Stand has provision for leg extensions of standard 1-in. conduit or pipe so that benders can be set any desired working height. New pawl and pawl release assembly provides easier accessibility. Protected location of control prevents accidental damage.

Lidseen of North Carolina, Inc., 1050 First St., Hayesville, N. C.



Yard Pole Switch (43)

For yard pole metering, the 201Y weatherproof switch provides 200-amp single phase service with ground level disconnect control. The galvanized, weatherproof cabinet is mounted at top of yard pole. It houses a 200-amp snap-action knife switch and 200/5 ratio current transformer. Current and potential leads for meter are prewired to a terminal strip. Insulated bushings are furnished for line and load leads. Mounting feet with holes are provided. Control handle is furnished to be installed at ground level.

Hoffman Engineering Corp., Anoka, Minn.

Switch (44)

The new Protect-O-Lite post lantern adapter contains a time delay photo electric eye switch which turns on the lantern at dusk and turns it off at dawn automatically. Lantern can also be controlled by regular switch. It can be installed on any 3-in. post regardless of lantern style. Operates on 115 volts ac with 400 watts capacity. It is unaffected by temperature changes.

Energy Kontrols, Inc., Geneva, Ill.

emost in comfort!

ANNOUNCING THE NEW

Honeywell Two-Piece, Low-Voltage Control System for Electric Heating

T86D HONEYWELL ROUND

Since 1950, Honeywell has featured low-voltage control for maximum comfort in electric heating. Now — after three years of extensive research and field testing, here is the most advanced low-voltage control ever available to the electric heating industry.

Here is the story behind the new two-piece low-voltage system that is completely revolutionizing the concept of comfort control for electric heating! It's the *only* thermostat-relay combination that precisely *anticipates* comfort requirements.

To attain the *very finest* control possible, the low-mass, exceptionally responsive 24-volt T86D Honeywell Round was created. This model was specially designed to provide rapid, frequent heat signals to a *second thermostat* — built into the R8097 Silent Relay. As a result of these two unique control units working in unison, electric heat is automatically increased or decreased *before* any changes can upset the comfort balance. Room temperature is therefore maintained at a stable level — regardless of sudden variations in weather or other factors affecting heat demand.

T86D HONEYWELL ROUND — built to give top performance with all types of electric heating. Sensitive, fast-acting mercury switching has sealed-in contacts — providing complete protection from dirt, lint, and oxidization. New compact round styling makes this an exceptionally attractive thermostat for any room. Decorator "ring"-type cover easily snaps off, and can be painted to match the wall.

R8097 SILENT RELAY — incorporates its own heat-accelerated bimetal thermostat that operates the load circuit to the electric heating unit. The frequency and duration of heating cycles depends upon the cumulative heater effect on the bimetal in the relay, as a result of frequent cycling by the Honeywell Round. Dependable, silent Honeywell MICRO SWITCH* enclosed snap-switch handles loads up to 4,000 watts, at 230 volts, ac.

R8097A — handles a single 4,000 watt circuit; R8097B — **two** 4,000 watt circuits, controlled by one T86D Honeywell Round. R8097C — handles **two separate** 4,000 watt circuits, each controlled by a T86D Honeywell Round. Overall size is 3⅞" wide, 4⅛" high, 1¾" deep. Case can be mounted in any position.

R8097 A, B, C. SILENT RELAY — can be wall mounted. Several can be grouped conveniently near service entrance.

*Trademark

R8097 SILENT RELAY

Honeywell

First in Control

SINCE 1885

TURN PAGE — Honeywell Two-piece, Low-Voltage Control System also used with new **Weather Station** panels.

Introducing a new idea in centralized temperature control

THE HONEYWELL ELECTRIC HEATING

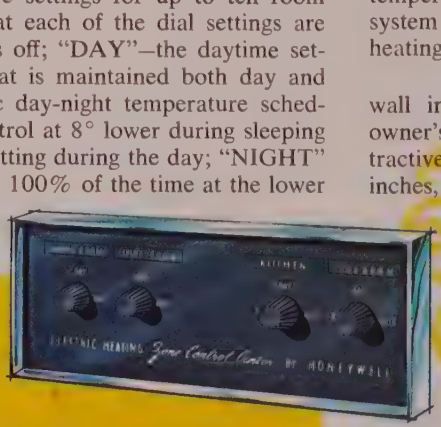
Weather Station

Here's a new symbol of the *finest* in home comfort for the electrically heated home. Just think – in one handsome, convenient panel – the Weather Station provides indoor temperature and humidity indication, outdoor temperature and barometer readings. A handsome electric clock is included, which regulates the fully automatic day-night temperature control schedule.

Lower portion of this unusual new panel contains remote manual temperature settings for up to ten room thermostats. Adjustments at each of the dial settings are as follows: "OFF"–heat is off; "DAY"–the daytime setting of the room thermostat is maintained both day and night; "AUTO"–automatic day-night temperature schedule is maintained, with control at 8° lower during sleeping hours, and at the regular setting during the day; "NIGHT"–room thermostat operates 100% of the time at the lower night temperature. With the automatic night setback fe ture, healthful, more economical lower temperatures a maintained during sleeping hours. Temperature is aut matically restored to the daytime setting when the fam awakens. The day-night temperature schedule is set at t clock.

The T86D Honeywell Round – the thermost specially designed to give the *very finest* in low-volta temperature control for electric heating – is used in th system to maintain desired temperature in each of t heating zones.

The panel can be conveniently mounted on a wall in the kitchen, hall, or den. Settings are at the hom owner's fingertips – at one central location. Dials are a tractively illuminated at night. Panel measures 7⅝ x inches, is finished in rich gray and satin aluminum.



ELECTRIC HEATING ZONE CONTROL PANEL

From a single convenient central location, this attractive new panel permits manual control of night temperature setback for any or all of the thermostats in the system. The panel shown above is designed with four rotary switches – each capable of adjusting one or two zone thermostats. Models are also available with two, three, or five switches. Settings are OFF, DAY, NIGHT. In the "off" position, heating in all rooms is shut-down. The day setting permits normal daytime room temperature. With any switch turned to the night setting, control point for that zone is set back – providing a more economical, restful lowered temperature during sleeping hours. Panel is gray with satin finish aluminum trim, and measures 4 11/16 x 10 11/32 inches.

Honeywell

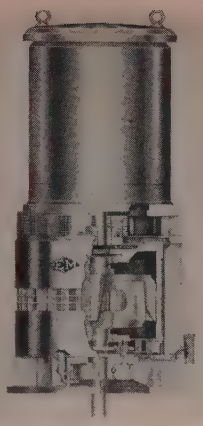
First in Control

H HONEYWELL SINCE 1885

MINNEAPOLIS 8, MINNESOTA • TORONTO 17, ONTARIO

... PIONEERING THE FUTURE

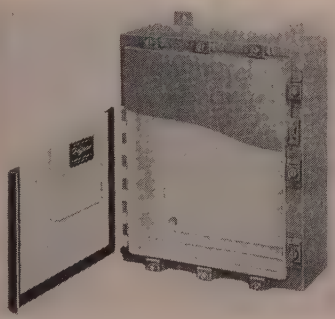
76-8552 2-60 PRINTED IN U.S.A.



Magnetic Drive (45)

A new line of vertical magnetic drives, called "Ampli-Speed," is designed particularly for pump drive applications. Made in five sizes, they can provide variable pumping speeds over a range from 0-1740 rpm. Unit is air cooled and technically it is called an eddy current slip device, utilizing two rotating members which "slip" with respect to one another. Drive control is all transistorized and is mounted in its own small cubicle. Unit is built to match most vertical induction motors or is built integrally with an E-M induction motor. Literature is available.

Electric Machinery Mfg. Co., Minneapolis 13, *Minn.*



Panel Enclosures (46)

NEMA Type 4 panel enclosures made of sheet steel are designed to house electrical controls in areas which must be regularly hosed down or are otherwise very wet. They may be used both in and out-of-doors. Each enclosure has a removable panel mounted on studs. Exterior mounting feet are provided for wall-mounting the cabinet. Standard sizes for single door, wall mounted models range from 16 by 12 by 6 in. deep, to 60 in. by 36 in. by 10 in. deep.

Hoffman Engineering Corp., Anoka, Minn.

Gearshift Drive (47)

Redesigned internally, the Type R3 selective 4- or 8-speed gearshift drive is now available for mounting in any position required—standard horizontal; ceiling; wall, horizontal or vertical, with the output shaft up or down. Design changes include stress-proof steel shafting in motor and gear box, with hardened splines on spline shaft. Type R3 is furnished with standard single-speed motors of 1800, 1200 or 900 rpm. Two-speed motors are available and hp ratings of 1, 1½, 2, 3 and 5. Type R3 drives are furnished to operate on standard 208,220/440 or 550-volt, 3- or 2-phase, 60-cycle.

Lima Electric Motor Co., Inc., Lima, Ohio

Magnet Brakes (48)

This line of dc magnet brakes has been redesigned to provide increased reliability and simplified maintenance. Key features are an improved epoxy-potted magnet coil assembly, single-end adjustment, and exclusive slip-in brake lining replacement. All adjustments and settings are made from one end of the brake. The brakes, in 8-, 10-, 13-, 16-, 19- and 23-in. wheel sizes, are spring-set, shoe type friction brakes, built to NEMA-AISE standards. They can be either left- or right-hand mounted. Although designed for floor or ceiling mounting, they can be adapted for motor-mounting or vertical mounting.

General Electric Co., Schenectady 5, *N. Y.*

Capacitors (49)

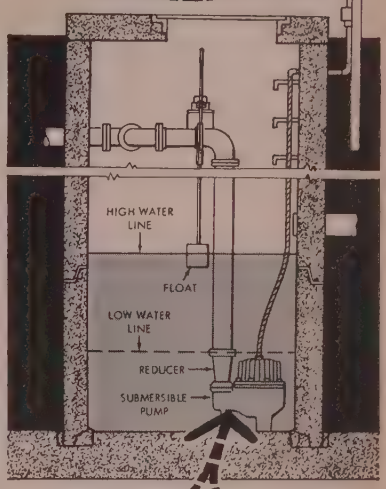
Cornell-Dubilier utility type capacitors are for power factor improvement in outdoor systems of both low and high voltage. The pole-type capacitors are available in kvar ratings of 15, 25, and 50 with voltage ratings of 2.4 through 14.4 kv. Units of 100 kvar are also available in voltages from 2.4 through 7.96 kv. Units feature: corrosion resistant finish; solder seal bushings; discharge resistors; and side-mounted lifting lugs. Also available are capacitor assemblies with pole-mounted distribution racks of in-line, cluster, rectangular, and contour types, all of which can be supplied as switched or unswitched equipment.

Federal Pacific Electric Co., 50 *Paris St., Newark* 1, *N. J.*

* "MARKETS UNLIMITED" *

Add-A-Phase®

HERE



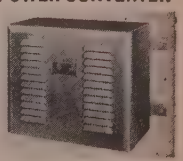
means 3-PHASE 220 or 440 SUBMERSIBLE OPERATION HERE from Single Phase Lines

Now, get all the benefits of dependable 3-phase submersible pump operation and be assured of trouble-free, continuous full power output with the ADD-A-PHASE Power Converter. Absolutely no expensive 3-phase wiring necessary. The Add-A-Phase is easily installed by any qualified electrician.

UNIT BALANCES OUT PERFECTLY FOR ANY LOAD

Add-A-Phase POWER CONVERTER

- 100 % Rated Load
- High Power Factor
- Balanced Currents
- No Loss of Work Power



Write for Complete Information

ADD-A-PHASE EC
Div. System Analyzer Corp., Nokomis, Illinois

Gentlemen: Please send, without obligation, complete details on your ADD-A-PHASE Power Converter.

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____

State_____

SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.

Ice Capades Inc.

"The Greatest Show on Ice"
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SCR® DIMMERS†
by
KLIEGL
The Greatest Dimmers on Earth!

The Kliegl manufactured Stage Manager's "Nerve Center" contains 6 SCR Dimmers (24,000 watt total capacity) for lighting control. In addition, it has controls for curtains and hoists . . . intercommunications system . . . power panel for feeding back-stage electrical equipment . . . in a few words *complete electronic control in a compact portable console.*

Compactness is possible *only* with Kliegl SCR Dimmers and no other dimmer can offer comparable versatility, flexibility and ruggedness.

Contact Kliegl Brothers for complete information on the job-tested SCR method of dimming control.

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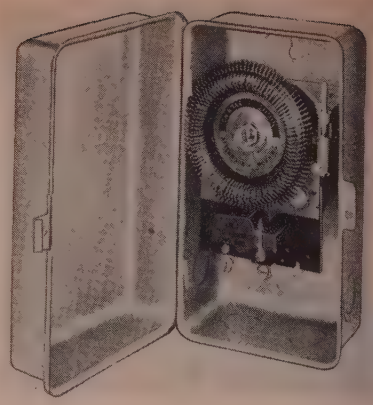
321 W. 50th ST., NEW YORK 19, N.Y.
ORIGINATORS AND MANUFACTURERS OF KLIEGLIGHTS



Time Switch **(50)**

A program time switch for 440-volt use has built-in 440/120-volt step-down transformer to eliminate motor burnout. This permits use of a standard 120-volt motor. The time switch itself allows for programming of any intermittent daily operation. ON-OFF settings are in multiples of 15 minutes.

Tork Time Controls, Inc., Mount Vernon, N. Y.

Safety Switch **(51)**

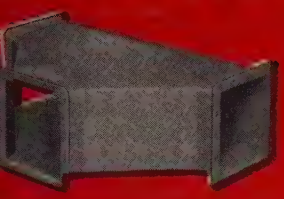
A new heavy-duty NEMA 12 safety switch with a completely redesigned padlock attachment, accommodating up to four padlocks, plus a cover padlock if required. In addition, switch can be locked in ON position if required by punching out a small knockout.

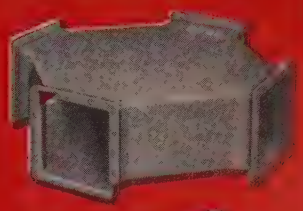
Square D Company, 1601 Mercer Road, Lexington, Ky.

Fittings **(52)**

Redesigned fittings for the line include new "T" fittings, 90° elbow and pull boxes, as well as cross pull boxes. New angular side design gives more interior room in units, and conductors bend more easily at corners. Also available are new 45°,

BOSS . . . COMPLETE LINE OF ELECTRICAL ENCLOSURES



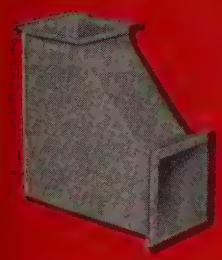


BOSS J.I.C. Wireway and Fittings

Flanged Hinged Cover Wireway & Fittings

Flangeless Screw Cover Wireway & Fittings

Flangeless Hinged Cover Lay-In Wireway & Fittings



"The Line of Least Resistance"

BOSS

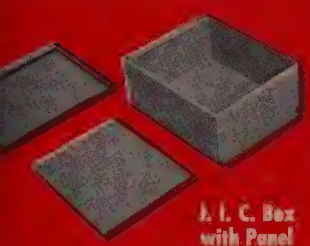
You can always be sure of *excellent quality* and *prompt delivery* on stock or "specials" with the complete line of BOSS Boxes, Wireway and Fittings.

Job-engineered for quick, easy installations, BOSS enclosures are code gauge steel, have smooth corners, with firm but easy knockouts. All units are *UL approved*. Finished in durable gray baked enamel.

BOSS now also offers you new *Oil Tight* Push Button Enclosures for excellent protection against oil, dirt and liquids.

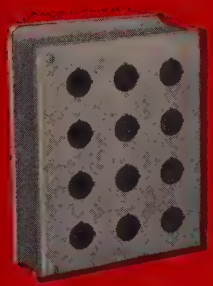
Write for Catalog on the complete line of BOSS Electrical Enclosures.

Sold thru leading distributors everywhere

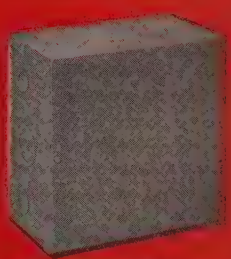


J. I. C. Box with Panel

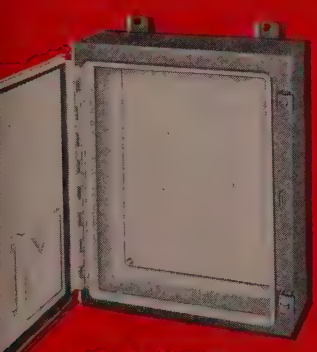
Type "A" Box



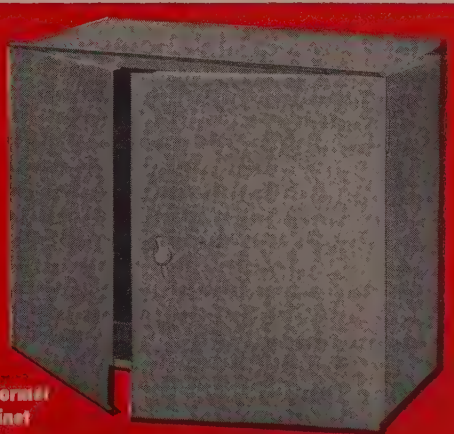
Oil Tight Pushbutton Enclosure



Screw Cover Pull Box



NEMA 12 Cabinet

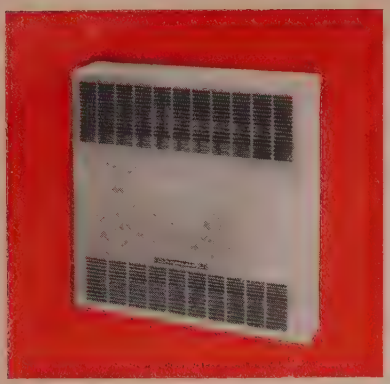


Transformer Cabinet

Telephone Cabinet

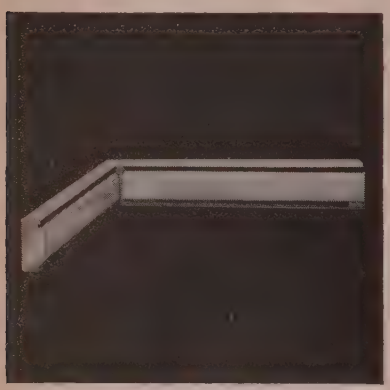
You can rely on BOSS for custom fabrication of your "specials" of any type

THE HUENEFELD CO. Engineered Products Division

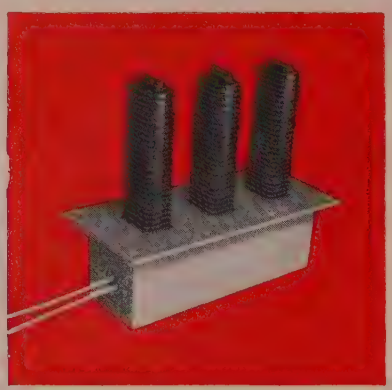


Cabinet Convector Heater. Free-standing or semi-recessed wall mounting. Built-in thermostat available. Various sizes and wattages.

Wall-insert Heaters quickly and quietly heat gamerooms, laundries, workshops, bathrooms . . . with thermostat or manual control.



New Trim Line Baseboard with Thermal Sentry that fully protects against any possible "overheating."



Forced Air Duct Heaters for use with air conditioning systems, as boosters for existing heating duct systems, and for reheat.

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For every home heating problem, Chromalox has a heater. New, lower baseboard design with unbreakable Chromalox tubular heating element, Chromalox Thermwire Ceiling Cable, Wall-insert or Floor-insert Heaters, Duct Heaters . . . even outdoor Concrete Heaters, for installation in driveways, walks and steps to prevent snow and ice accumulation.

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Write today for Residential Heating Catalog F-1005-2. Special literature also available on Snow Melting (driveways, steps, sidewalks) . . . Swimming Pools (water heating, radiant comfort heaters, pool aprons) . . . Schools, Motels and other Commercial and Industrial comfort heating.

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22½°, 7½° elbows, "U" connectors, panel adapters for connecting wireways, panelboards and switchgear, as well as lay-in adapters for changing position of wireway runs. All standard wireways and fittings are made of heavy gauge steel, with a corrosion-resistant baked on gray enamel finish. They are available in standard stock sizes of 2½- by 2½-in., 4- by 4-in., 4- by 6-in., 6- by 6-in., and 8- by 8-in., in lengths from 1 to 5 ft.

Keystone Manufacturing Co., 23328 Sherwood Road, Warren, Mich.

Core Bits (53)

A new line of thin wall Diamond surface set and impregnated masonry core bits for coring reinforced concrete, tile, asphalt and many other similar hard materials. They are available in diameters from ⅜ in. to 14 in., in lengths up to 14 in. Thin wall bits core at speeds up to 6 in. per minute in hardest masonry.

Hoffman Bros. Drilling Co., Punxsutawney, Pa.

Product Briefs

(54) Empire Level Mfg. Co., Milwaukee, Wis., has introduced a new magnetized **level** designed for metal workers. . . . (55) A new and improved line of **work platforms** has been announced by the Atlas Industrial Corp., Brooklyn 32, N. Y.

(56) Photoswitch Div., Electronics Corp. of America, Cambridge, Mass., has developed a new line of transistorized tubeless photoelectric **controls** for industrial use. . . . (57) A new 750-watt narrow beam **spotlight lamp** has been introduced by the Radiant Lamp Corp., Newark 8, N. J.

(58) Westinghouse Electric Corp., Pittsburgh, Pa., announces new polyester-treated **glass tape** for banding rotating apparatus. . . . (59) New unbreakable **street light globes** are now being marketed by Plastic Age Sales, Inc., Saugus, Calif.

(60) Adam Cook's Sons, Inc., Linden, N. J., has developed an Albany RBR **wire pulling compound** which is UL approved for rubber, plastic and lead coated wire; non-metallic cable. . . . (61) A new grade of insulating **varnish** for Class F applications is now available from Westinghouse Electric Corp., Micarta Division, Pittsburgh, Pa.

Catalogs & Bulletins

(62) VOLTAGE REGULATORS for ac generators and generator-exciters, three models with selenium rectifiers and one with a sealed silicon rectifier for corrosive atmospheres, are described in 4-page Bulletin 3200. Fidelity Instrument Corp.

(63) NAMEPLATES of aluminum with black enamel finish suitable for controls, panels, switches and other equipment are covered in Bulletin 900, 2 pages. Seton Name Plate Co.

(64) MULTI-OUTLET MOLDING. Two data sheets, F21 and F22, show the use of Plugmold 3000 on benches to handle diversified testing equipment and to carry branch circuits for instrument repair. The Wiremold Co.

(65) POWER FUSES from 2.4 to 138 kv and metalclad switchgear fuses. Bulletin 205 gives ratings with and without mufflers, for indoor and outdoor holders, and for solid-material and liquid fuses. S&C Electric Co.

(66) ELECTRICAL CORDS with yellow neoprene jacket for maximum visibility in all locations are covered in new 4-page bulletin. Western Insulated Wire Co.

(67) MOTOR-GENERATOR CHARGERS. Bulletin 5845, 8 pages, gives instructions on operation and long-range preventive maintenance of chargers in electric industrial truck and other motive power applications. Exide Industrial Div., The Electric Storage Battery Co.

(68) CONVECTION HEATERS. Bulletin L-1251 describes many uses of commercial grade electric cabinet heaters. Edwin L. Wiegand Co.

(69) CONNECTORS. Bulletin B77 tells general design story behind integrated cable connectors with information on designs for special applications. Joy Mfg. Co.

(70) LIGHTING FIXTURES. New catalog designed for use by the contractor and builder contains data on over 150 best-selling fixtures. Lightolier Inc.

(71) WIRE AND CABLE TERMS. Pocket-sized glossary lists alphabetically common terms, expressions, and units used in the wire and cable industry. Standard Wire and Cable Co.

the DAVIS PUP TRENCHER
IS POSITIVELY SELF-PROPELLED

trenches while you do other work!

The portable, self-propelled Davis Pup Trencher has proven itself as the most valuable trenching tool available for assignments from 2" to 3" wide to 36" deep or 4" wide to 18" deep. Users have reported it has paid for itself on the very first job.

It is positively driven by a simple, six-speed winch mechanism that pulls it down the line you want dug. Since it doesn't require constant supervision, you are free to take care of other work on the job — such as prepare pipe or cable for the trench. It disturbs a minimum of turf so backfilling is easy.

The Davis Pup has quality features throughout, but it is still priced less than comparable trenchers. Compare it for performance, quality, and price. See if you don't agree that pound for pound, dollar for dollar, it's your best trenching buy!

and if you need to go larger — the NEW DAVIS T-66 fills the bill!

This amazing trencher features positive traction, hydraulic variable speed drive, accurate speed control, hydraulic boom control, pre-loaded shock absorbing boom, and convenient — virtually effortless — operation. Digs 3" to 4" wide to 66" deep or 12" wide, 30" deep and varying depths and widths in between. Compact design with 1350 lbs. total weight; only 37" wide. Has well-designed backfill blade attachment, two-speed drive with instant forward or reverse, and many other features. Ask about its 90-day unconditional guarantee!

the PERFECT VEHICLE FOR TRANSPORTING TRENCHERS AND SUPPLIES

THE DAVIS HUSTLER

This 2000-lb. capacity utility trailer was especially designed for the T-66, but it has a wide range of uses. Deck is 48" x 84". It has a low center of gravity and provides load equalization regardless of load distribution.

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Please send me literature and tell me the name of the distributor for the Davis Pup_____Davis T-66_____Davis Hustler Utility Trailer_____

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P-60-2

Pays for itself quickly 3 ways;

- Costly oil is screened and re-used—no waste, no messy floors
- Well oiled dies last longer . . . give cleaner, sharper threads
- Sharp, clean-cut threads mean fast, easy installations.

Check the Specs: Screened chip pan traps metal scraps, cleans oil for re-use. Flexible hose carries oil from reservoir to easily operated pump-gun. Snap latches and rubber gasket seal chip pan to reservoir for easy splash-proof carrying. Use it once and you'll wonder how you ever got along without it. See it at your Supply House!

The Ridge Tool Company . Elyria, Ohio, U.S.A.

(72) VAPORTIGHT LIGHTING. Bulletin 652 covers design, technical data and prices of new line of industrial vaportight fixtures. Pyle-National Co.

(73) DRILLING MACHINES. New bulletin covers diamond drilling machines, diamond bits and accessories, and saws, with installation hints. Truco Masonry Drilling Div., Wheel Trueing Tool Co.

(74) SERVICE STATION LIGHTING. 56-page book catalogs complete line of fixtures, poles and accessories, with all information necessary for planning and ordering a complete lighting installation for a modern service station. Revere Electric Mfg. Co.

(75) LIGHTING CALCULATOR. Panel area calculator is designed to determine the lens panel square footage necessary for any lighting job. K-S-H Plastics Inc.

(76) PENDENT SWITCHES for electric hoist control, available with 2, 4 or 6 buttons and 1- and 2-speed control are covered in 8-page bulletin. Joy Mfg. Co.

(77) MOTORS, geared and non-geared, from 1/2000 to 25 hp for special machinery, research and development. 28-page catalog. B&B Electric Motor Co.

(78) WOODWORKING TOOLS. Bulletin H-308, 6 pages, covers auger and expansive bits, power bits, chisels, screw drivers and push drills. Greenlee Tool Co.

(79) LIQUID LEVEL CONTROLS. Condensed 4-page catalog describes 2- and 3-pole controls and enclosures, pump controls, control panels, electrodes, and electrode fittings. Charles F. Warrick Co.

(80) REVERSING DRUM SWITCH. Bulletin GEA-7000, 2 pages, gives data on new switch for control of single-speed motors up to 2 hp. General Electric Co.

(81) CHURCH HEATING. Bulletin F00102, 4 pages, describes benefits and economic advantages of heating churches electrically. Edwin L. Wiegand Co.

(82) BUILDING WIRE. Synthinol 901 applications, physical properties, and electric characteristics are given in 4-page bulletin. Rome Cable Div. of Alcoa.

(83) LIGHTED CEILINGS. 4-page brochure describes wall-to-wall lighted ceiling installations, modular units, and panels for homes and offices. Diffusa-Lite Co.

(84) EXPANSION SHIELDS, machine screw anchors, wood screw anchors, and masonry drills are covered in pocket-sized Catalog 160. Diamond Expansion Bolt Co. Inc.

(85) GENERAL-PURPOSE MOTORS. Bulletin GEA-6424A, 12 pages, discusses benefits and features of Form G fhp motors, single phase and polyphase. General Electric Co.

(86) ELECTRIC PLANTS and controls. 8-page folder tells how to select and install standby systems. D. W. Onan & Sons Inc.

(87) FITTINGS. 20-page Bulletin Vol. 2 No. 6 illustrates and describes complete line of conduit and cable fittings and connectors. M. Stephens Mfg. Inc.

(88) LIGHTING AND CONTROLS. Catalog 101, 44 pages, includes specifications, data, circuiting and dimensional information on lighting equipment. Hub Electric Co. Inc.

(89) LAMINATES. Two bulletins, 63-060 and 63-061, describe Micarta thermosetting laminates for switchboard panels, armature wedges, transformer coil spacers. Westinghouse Electric Corp.

(90) PROTECTIVE RELAYS — their characteristics, design and application—are covered in Bulletin 6200, 6 pages. Federal Pacific Electric Co.

(91) ELECTRICIANS' TOOLS, including conduit benders, pipe pushers, cable pullers, knockout punches, power pumps and smaller tools are described in 8-page Bulletin E-240. Greenlee Tool Co.

(92) GEAR MOTORS and motor reducers. Bulletin 198, 8 pages, covers features and mounting positions of the Slo-Speed line. Sterling Electric Motors.

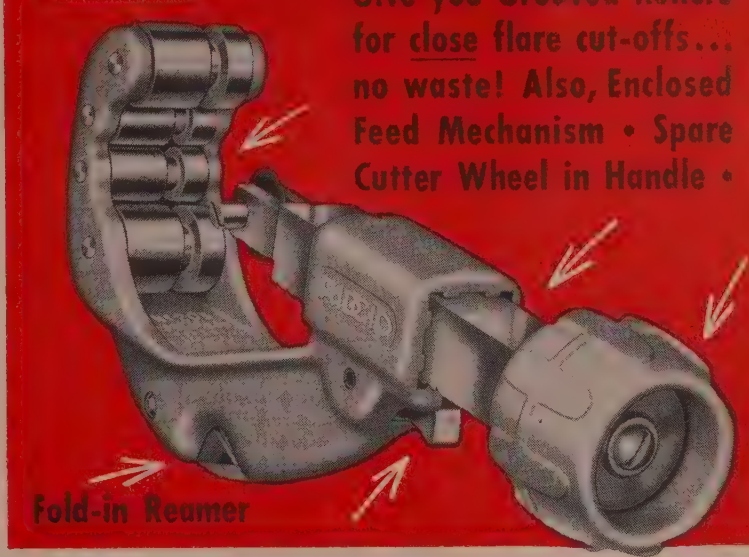
(93) INSULATION TESTING. 32-page manual, "Insulation Resistance Measurements," contains step-by-step procedures for maintenance testing of insulation resistance of motors, generators, transformers and other devices. Associated Research, Inc.

(94) MOTORS AND RELAYS. Folder F-9765, 4 pages, illustrates and gives specifications on complete line of ac and dc fhp motors, tachometer generators and ultra-sensitive relays. Barber-Colman Co.

(95) RELAY COILS. 2-page bulletin describes solution to relay problem using more ampere-turns within a given volume on thin bobbins. Turbo Jet Products Co.

2 New RIDGID Tubing Cutters

Give you Grooved Rollers for close flare cut-offs... no waste! Also, Enclosed Feed Mechanism • Spare Cutter Wheel in Handle •

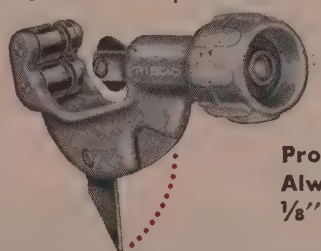


RIDGID No. 205 Tubing Cutter

Time-Saving, Slide-to-Size 1/8" to 2 3/8" O.D. Capacity

Made of lightweight, high-strength cast aluminum alloy, you'll find these new RIDGID Tubing Cutters extra handy. Slight push on handle of large-size-range RIDGID No. 205 snugs cutter wheel against tubing . . . locks it in position until released. Feed screw fully protected and enclosed . . . always feeds into tube with easy handle turn . . . can't jam with chips or dirt. Wheel gives quick, clean cuts of copper, brass, aluminum tubing and thin-wall conduit . . . no burr. Grooved rollers give easy flare cut-offs without tubing waste. Tubing always turns freely on 2 of 4 Rollers. Rollers smooth tubing ready for soldering. Fold-in reamer always handy. Spare cutter wheel in handle. Wheel for plastic and aluminum pipe available for No. 205 only.

Conform to Fed. Spec. GGG-C-771b Type II—Class I—enclosed feed mechanism



RIDGID No. 105 Tubing Cutter

Protected Feed Screw
Always Easy-Turning
1/8" to 1 1/8" O.D. Capacity

To save time on thin-wall conduit jobs, order these new RIDGID Tubing Cutters today! Your Supply House has them!

RIDGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.

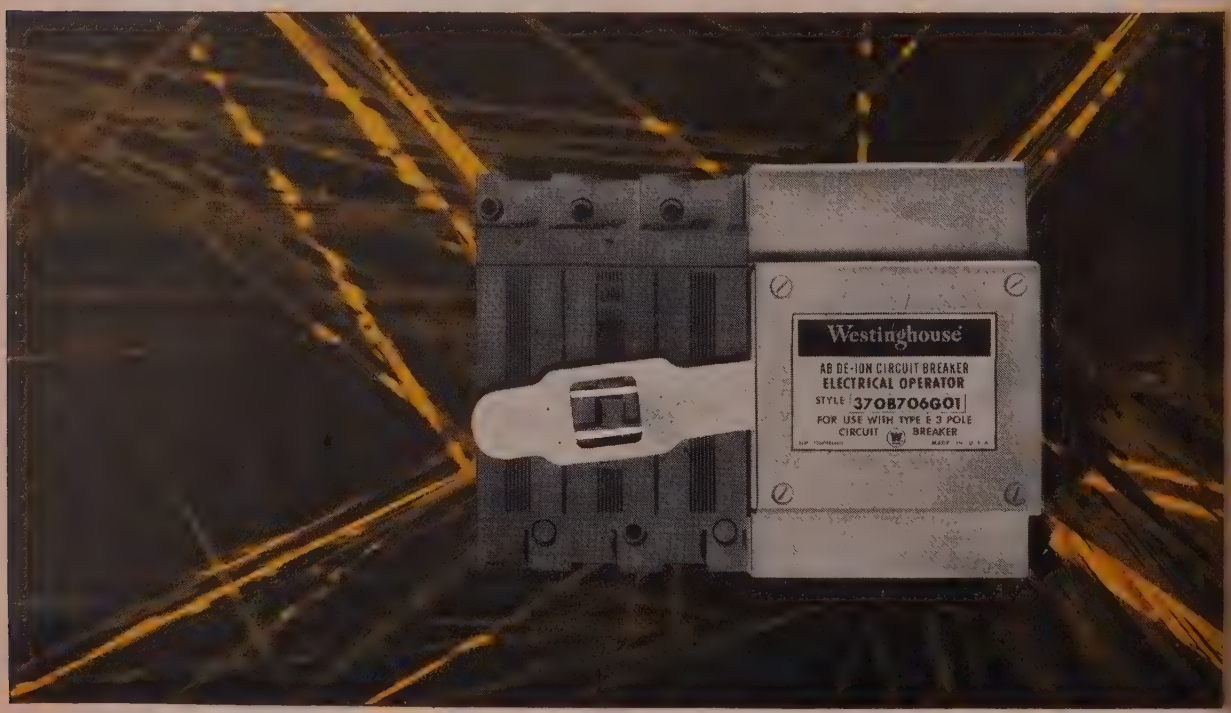
NOW . . .
REMOTE CONTROL
FOR WESTINGHOUSE
TYPES E, EH AND F BREAKERS

This magnetically operated unit turns your types E, EH and F breakers into a remotely controlled switch for—service entry panels—control panels—billboard, railroad yard, parking lot and industrial lighting systems. Use it as a remote switch for battery chargers—engine generators—you can think of a score of other uses.

☐ This new Westinghouse Electric Operator is the same size and fits the same space as the breaker it controls. Its action is strong and positive, with the advantage of manual control when desired. In fact, this new electric operator does the same job for the smaller breakers that a motor operator does on the larger type breakers. What's more, the cost is much less. Electric operator works on 120, 240, 480 or 600 volts a-c; 125 or 250 volts d-c.

☐ There's a 4-page, 2-color illustrated brochure available describing more about the Westinghouse Electric Operator. For your copy write: Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa. J-30315

YOU CAN BE SURE...IF IT'S Westinghouse



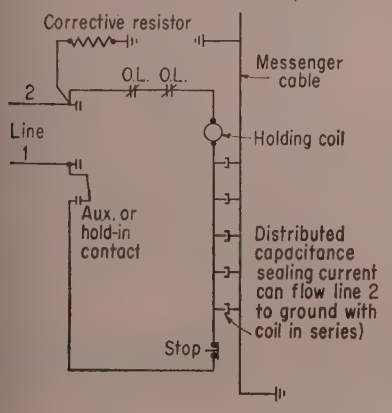
QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Motor Control Delay

QUESTION L37—We have recently had a lot of trouble with one of our motor starters. Starter is a 7½-horsepower combination type motor contactor and fused disconnect. We have been having trouble with the starter not dropping out when the stop button is pushed. This doesn't happen all the time, but happens enough to give us considerable trouble. This motor operates a feeder to a conveyor belt, so it is important that the feeder shut down when the belt stops. We suspect it is due to the control cable having an induced voltage in it, causing it to hold the starter in. The pushbutton and interlock are connected to the starter with 1000 ft of 3-wire tirex cable strung on a messenger cable. The power cable for the starter is also strung on the same messenger and is a four-wire tirex cable. There are also a number of other cables of the same type strung on this messenger supplying other feeders. I would appreciate some advice on how to cure this trouble. —E.T.

ANSWER TO L37—The problem is believed to be one of capacitance rather than induction. It is assumed that the cables strung on the messenger are for 3-phase power and normally these have the effect of cancelling external induction.

In the 3-phase starter, the coil is generally connected to one line through the overload contacts with the other side of the coil connected to the pushbutton. The accompanying diagram indicates the shunt capacitance to ground of this arrangement. On long control circuits this can permit a sufficient flow of current to hold or seal the magnet in the closed position when the control circuit from Line 1 is opened with the stop element.



A simple correction is to connect a resistor from the line, that is direct to the coil, to ground which has the effect of shunting the coil terminals through a high impedance circuit.

The calculation of the capacitance is too involved to justify the effort and the remedy is simple and inexpensive enough to justify its trial. The resistor should be large enough to prevent undue waste of power and prevent excess heating. For 220 volts, I would suggest 10,000 ohms rated 10 watts or more. This would give a 5-watt loss as follows: Watts $= E^2/R = 200^2/10{,}000 = 4.84$w. Calculations for other voltages could be made on the same basis.

The method proved satisfactory a few years ago for an identical problem involving a well pump and tank controls that were widely separated.—W.L.D.

ANSWER TO L37—The reason for the starter not dropping out when the stop button is pushed is definitely not due to induced current in the line. In the first case there can be an induced voltage, but unless the leakage resistance between lines is extremely low, the impedance in the equivalent circuit is so high as to make the resultant current extremely low in the order of ma and fractions of a ma.

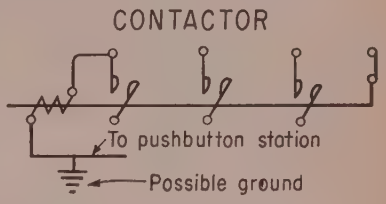
I would therefore immediately rule out any possibility of induced voltage or induced current holding in your magnetic starters.

What is more likely to happen is that your starters have had their poles banged out of shape and there is either a magnetic sticking existing between the moving part of the starter magnet and the fixed iron part or there might possibly be some oil or dirt in the moving part.

I would strongly urge you to take apart your starting magnets and to check them through carefully, paying particular attention to the free motion of the contact assembly.

Another possibility is that the contacts have become very badly pitted and that they have welded themselves together.—H.H.S.

ANSWER TO L37—Some time ago we were faced with a similar situation when the contactor would not drop out; however when the disconnect switch was opened the contactors would drop out. When the disconnect switch was closed, the contactors would not pull in, which was normal.



We realized that the wire of the holding circuit coil to the pushbutton station was grounded. This condition occurred as you described on occasions indicating that the grounded wire touched some piece of metal under vibration.—I.M.W.

Cable-Break Test

QUESTION M37—In our quarry operation, we have a problem in maintenance of our shovel 2300-volt trailing cable.

In moving from location to location, the cable is frequently subjected to breaking strains.

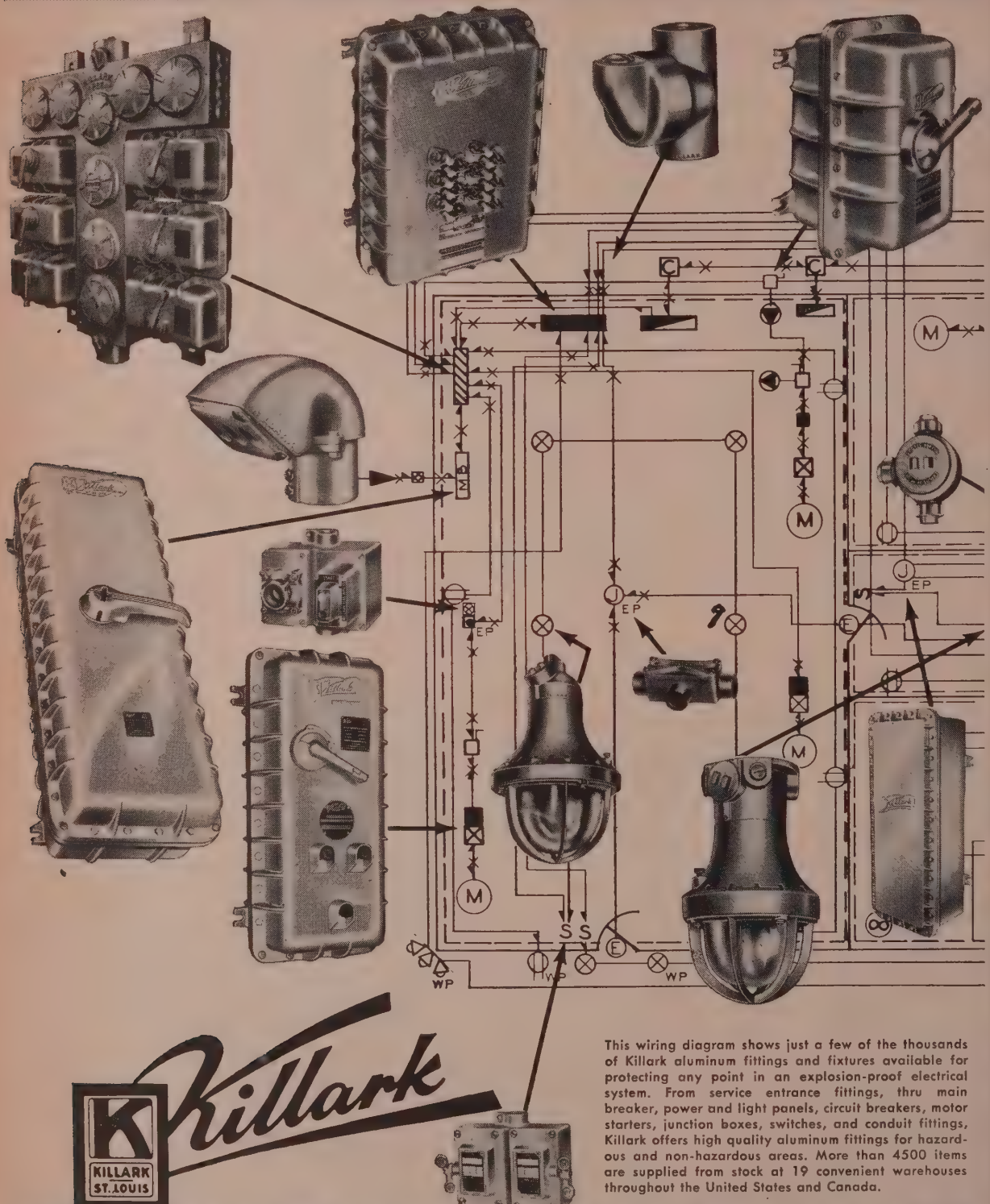
Our problem then is to locate breaks in the cable which would not be evident on the surface. At present, we cut the cable at a splice and test both ways.

We would like some method using an explorer coil and earphones which would exactly locate the trouble.—V.W.B.

ANSWER TO M37—We are pleased to advise that there is actually an instrument available on the market called a Cable Tracer. This instrument is made in Germany but is available in the United States through the Curtiss-Wright Corporation.

This instrument is actually nothing more or less than a very small transistorized audio amplifier. It has for a pick-up, a ferrite core which acts as a loop antenna. This loop antenna picks up any radiated magnetic field and amplifies it. The output of the amplifier is fed to a set of terminals where an earphone

Killark supplies all the explosion



This wiring diagram shows just a few of the thousands of Killark aluminum fittings and fixtures available for protecting any point in an explosion-proof electrical system. From service entrance fittings, thru main breaker, power and light panels, circuit breakers, motor starters, junction boxes, switches, and conduit fittings, Killark offers high quality aluminum fittings for hazardous and non-hazardous areas. More than 4500 items are supplied from stock at 19 convenient warehouses throughout the United States and Canada.

Killark

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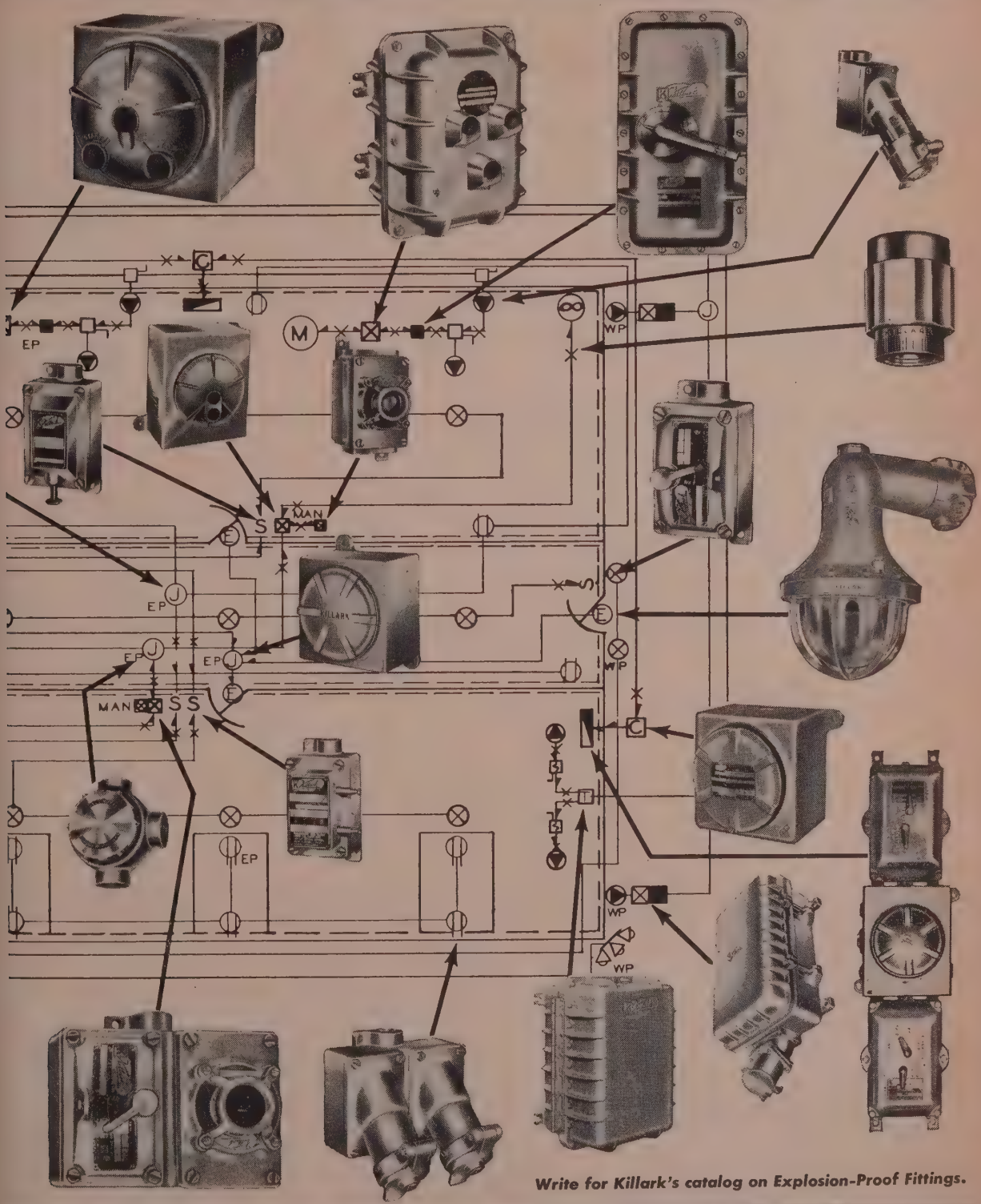
-proof equipment you need...



Write for Killark's catalog on Explosion-Proof Fittings.

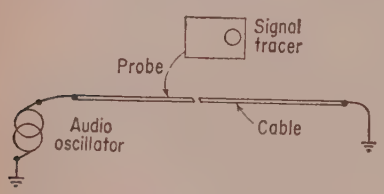
can be plugged in. At the same time, an indication is given on a meter needle so that the signal can be traced both aurally and visually.

The instrument also has a small capacitance plate so arranged that it will pick up an electrostatic field. This is done by simple switching on the face of the instrument.

Thus, if the cable is energized but no current is flowing, it is possible to follow the electrostatic field and to locate the break by noting where the electrostatic field decreases sharply. On the other hand, if there is a short in the cable, by feeding in a relatively small current it is possible to trace the current all the way along until it suddenly diminishes where of course the short circuit appears.

In addition to this cable tracer, the Metrawatt Co. has developed a small transistorized battery-operated audio oscillator. This oscillator has two outputs, the first a high current at low voltage and the second a high voltage at low current. The high current output is used where one wants to locate a fault and the high voltage is used where one wants to locate an open. The audio-oscillator operates at approximately 1,000 cps, since the ear is much more sensitive to this tone than 50 and therefore it is possible to pick up and locate stray magnetic and electrostatic fields relatively simply.—H.H.S.

ANSWER TO M37—Apply an audio signal to one end of cable and ground the remote end of cable.



Then use a serviceman's type of audio signal tracer with a probe that passes over cable from one end to the other.

Pickup signal will fade out at break.—J.B.

ANSWER TO M37—If the faults occurring in the power cable are opens, the location of the fault can be found by applying sharp-fronted pulses of high voltage to the cable. The voltage must be sufficiently high to cause an electrical discharge across the gap presented by the break in the cable. Assuming two conductors denoted as "a" and "b," conductor "a" being good and conductor "b" having an open somewhere along its length, short "a" and "b" together at one end of the cable and apply the high-voltage, low-current pulses at the other end of the cable. A spark will then jump the gap in conductor "b." The spark will usually produce an audible pop and it may not be necessary to use any sort of earphone to locate the fault. An audio amplifier or RF detector can be used to aid in locating the fault if desired.

The equipment may be purchased or made up of suitable components. Various devices can be made to produce the desired pulses such as ignition systems, fence chargers, oscillators, etc.

Shorts and grounds may be located by applying an alternating current of audio frequency, say 1000 cps from some sort of oscillator. A telephone receiver connected to a pickup coil will detect this signal and when the fault is passed the signal will no longer be heard.—F.W.G.

Light Flicker

QUESTION N37—I have a customer who has an air compressor that runs much of the time. It is causing a flicker on the lighting in the near portion of the building. Would a capacitor connected to the circuit near the motor eliminate this flicker?

The motor is ¾ hp, 115/230 volts, 1.6/3.8 amps, currently connected for 115-volt branch circuit operation.

If the above is practical, what size capacitor would be correct?—L.E.M.

ANSWER TO N37—Before investing any money in a capacitor, I would check a few details of this particular installation and see what other measures were possible.

First—Is the motor on a separate circuit? Your statement could be taken to imply that the motor may be supplied from a branch circuit which also supplies lighting.

Second—Why not connect the motor for 230-volt operation? This would effectively reduce the flicker magnitude to one-half the present. This new flicker level may be permissible and unobjectionable.

Third—Is the compressor itself operating correctly? It may be that incorrect functioning of the compressor pressure control is causing the motor to be overloaded.

Fourth—Are the feeder circuit conductors supplying the branch panel adequate in size in reference to voltage drop due to the distance of the branch panel from the source?

Since the motor is apparently well loaded, the power factor should be high and the capacitor would help very little in this particular situation. (Incidentally, the motor speed is a determining factor in sizing the capacitor on a motor when both are switched as a unit in order to prevent over-excitation of the motor.)

I believe you will find that the branch circuit and/or feeder conductors are incorrectly sized, voltage-wise, although they may be adequate for the current load, and voltage drop was not taken into consideration. Some will disagree with me, but my personal opinion is this: Capacitors have their place in power-factor correction and in "unloading" feeders with a large reactive power component. However, capacitors are no substitute for adequate copper when it comes to limiting voltage drop and flicker. If capacitors are to be installed solely for voltage correction, I'd just as soon forget about them and get some copper "in back" of the load.—J.J.M.

ANSWER TO N37—I think your trouble is not electrical but mechanical.

If your drive from motor to compressor is faulty, this is your trouble. If you have a flat belt with metal lacing or a leather lacing, this will cause a fluctuation of voltage everytime the splice goes over the large pulley and there is a momentary stop which raises the voltage on the line then drops again, which in turn will show on the lights.

If you have a V-belt drive, an unevenness of the belt or a crack in the belt will cause the same thing.

A compressor with a faulty discharge valve will cause the same thing and the valve won't close quickly, causing a slight leak which causes the motor to load and unload, which in turn causes the voltage to rise and lower. If this is true a condenser will not remedy it.—J.P.

ANSWER TO N37—Before going into the question, some assumptions will be made to complete the picture. First, the ampere rating is given as 1.6/3.8 amps. For 115-230-volt rating, the ampere rating at 230 volts should be exactly one-half that for 115 volts. It is therefore assumed that the ampere rating should have read 1.8/3.6. It is also evident that with this approximate ampere rating the motor could not be ¾ hp; perhaps it should have read ½ hp. This size motor would indicate a single-cylinder compressor, and having 115-volt

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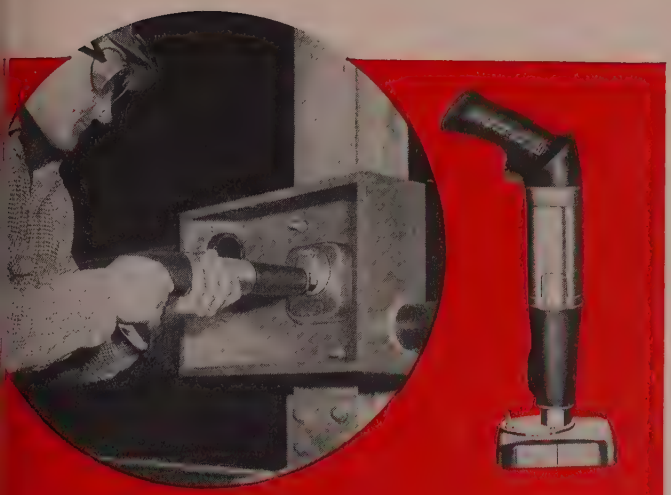

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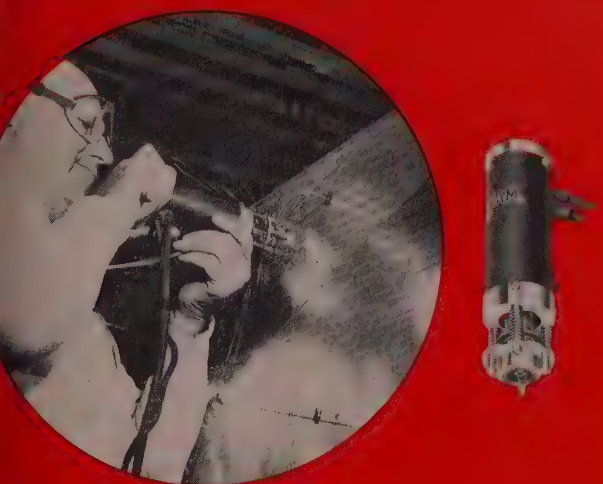

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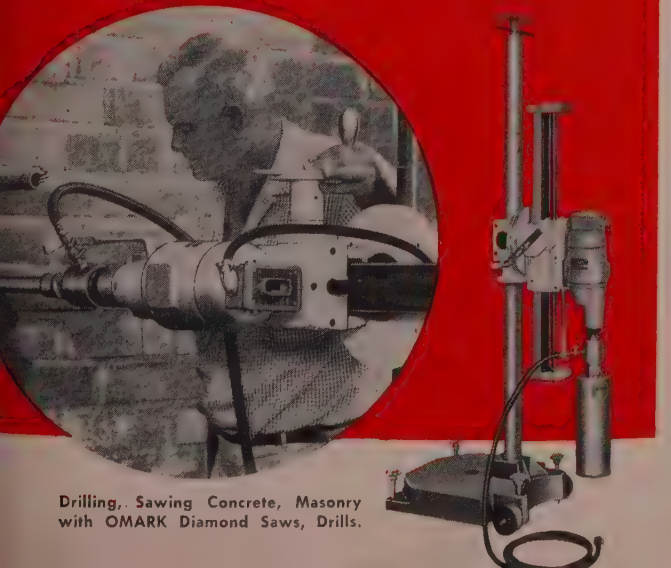

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connection, is probably connected onto a circuit also serving lighting.

An air compressor presents a constantly fluctuating load to the motor, with a peak toward the end of each compression stroke. This causes ampere load and therefore IZ drop from source to fluctuate also. The fluctuating voltage which results at the motor terminals will naturally affect any lighting which is connected to the same circuit near the motor.

The application of a capacitor will not "smooth out" this fluctuating voltage. It can however—by improving the power factor—reduce the ampere load and the IZ drop. This would require a capacitor of about 50 mfd, but maximum improvement would reach only about 35%. A far more effective improvement would result from separation of this motor from the lighting circuit, which most probably contains the major portion of the IZ drop. By running a new circuit to the distribution panel and connecting for 230 volts, the problem will disappear.—D.L.

Comment

Question C37 of our January issue was as follows:

"The plant where I am employed is about to make a purchase of a battery-driven pulp handling equipment. It is planned to use storage batteries for this application.

"Some engineers say it is best to use lead-acid batteries. Others say the Edison nickel-iron-alkaline storage battery is much better.

"How does the purchase price, efficiency, ruggedness, maintenance, life, weight, size and time required to charge each type compare?—M. D."

The two answers published favored nickel-iron batteries over the lead-acid type. These answers prompted a letter in which several statements are made concerning the comparison of nickel-iron and lead-acid batteries as follows:

Purchase Price—"An 18-MG-11 Exide-Ironclad, lead-acid battery (225-ah) sells for $882, about half the price of a 30-C-4 nickel-iron battery (same capacity), which sells for $1,620-36."

Efficiency — "The amount of work which an electric industrial truck will do is determined by the amount of sustained voltage applied to electric motors. Comparing lead-acid and nickel-iron batteries of equal capacity over an 8-hr discharge period, the lead-acid battery voltage will drop only about 14%, while the nickel-iron battery voltage will drop as much as 38 to 40%. As voltage drops and high current continues to be delivered, travel and lifting speeds decrease and motors get hotter. With intrinsically better voltage characteristics and with higher available electrical capacities, lead-acid batteries can minimize the voltage-drop problem."

Ruggedness — "Nickel-iron batteries have a critical temperature below which the output is small. A type A-6 nickel-iron battery, discharging at the normal rate of 45 amps, reaches this critical point when the electrolyte temperature falls to about 36 deg F. In contrast, a lead-acid battery still has about 67% of its capacity at 32 deg F. Also, nickel-iron batteries are much more vulnerable to damage by high temperature than lead-acid batteries. And freezing is not likely to occur, if the batteries are adequately charged so that the water is not separated from the acid. As for danger of damage from complete discharge or accidental short circuiting, there are no significant differences."

Maintenance — "A nickel-iron battery with electrical capacity equal to a lead-acid battery has one-third more cells which must be filled with water. They must be filled more frequently than lead-acid cells. Distilled water is required for nickel-iron batteries. In Exide-Ironclad lead-acid batteries, for example, most local water supplies are satisfactory. The alkaline electrolyte of a nickel-iron battery normally must be renewed two or three times during the useful life of the battery (with a complicated process). Lead-acid batteries never require renewal of electrolyte unless it is spilled or unless impurities are added. The acid does not evaporate or deteriorate. Only water needs to be added to the electrolyte. Nickel-iron batteries must be steam-cleaned and kept dry in order to prevent shorts and current leakage. Lead-acid batteries can be rinsed off with water or a soda solution, if spilled acid needs to be neutralized."

Life—"Average life of modern Exide-Ironclad lead-acid batteries in motive power service is 7½ to 8 years. There are records of Exide batteries giving more than ten years service."

Weight—The letter states that lead-acid batteries do not always weigh more than a nickel-iron battery of equal capacities. They further state: "Even if it were true that nickel-iron batteries generally weigh more than lead-acid batteries, the weight differential would give them no advantage in pulp handling equipment. In most such equipment, the weight of the battery is used to counterbalance the payload, extra weight—that the battery must propel—must be added to the vehicle."

Size—"New-type Exide-Ironclad lead-acid batteries have approximately 40% more electrical capacity-cube for cube- than nickel-iron batteries."

Charging time—"High ampere rates are needed for nickel-iron batteries in order to maintain them in a state of maximum activity. In contrast, with lead-acid batteries the charging current can be reduced as the potential of the battery rises. Little energy is wasted through gassing. The battery still can be fully charged in 8 hrs or less. The extra cost of charging current for nickel-iron batteries can be large because about one-third more current is used."

A number of the previous quotes were taken from "Storage Batteries," by Dr. George Wood Vinal.—M.L.F.

Can You Answer These QUESTIONS?

QUESTION X37—We use 3-phase, 440-volt hoists with 110-volt pushbutton controls on a traveling crane over paper machines. Power pickup is from trolley wheels on three open wires.

This crane may stand idle several days at a time, and the track collects dust and moisture and rusts; so the help gets a considerable shock at times off the pushbutton and lift chains. Solid grounding of the crane is not very feasible.

Would an isolation 1 to 1 transformer on such a circuit help much? I have thought perhaps an isolation transformer with a condenser and high resistance in each leg to ground might be a cure. If so, how much current would I have to leak to ground?—R.P.H.

QUESTION Y37 — An installation has a 240-volt, 3-phase, 3-wire system to accommodate the general purpose power requirements of three adjacent buildings. In building A is a center-tapped auto-transformer connected between lines 1 and 2 with its neutral grounded to supply 120/240-volt, single phase,

3-wire service in this building. Service to building B is provided in the same manner, except the transformer is connected between lines 2 and 3. Building C is similarly equipped, but connected between lines 3 and 1, so as to distribute the total load among the three phases. This system was installed and placed in service and has been in use for many months.

With the 120/240-volt, 2-pole main switch in building A open, the auto-transformer neutral was disconnected and some fireworks resulted.

Why did this occur inasmuch as the main switch was open?—R.D.A.

QUESTION Z37—We are confronted with the fact that one-half of a mine has 460 volts ac and an older portion 230 volts ac, both 3-phase, 60-cycle. Rather than change the hard-to-get-at taps to change motor connections on the welding machines, we are planning to install auto-transformers to step down the voltage permanently for the instances where a quick change of welders is in order.

In Fig. 1 note that the primary and secondary winding are tied together electrically. Having no experience with the idea, the question is are there any objections by the readers who have used the circuit?

Fig. 1

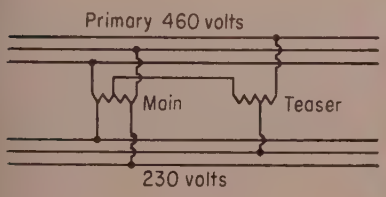
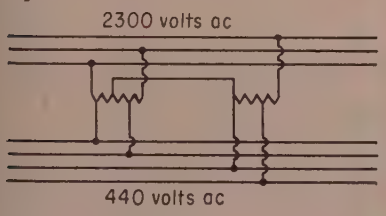


Fig. 2



Again stuck with two systems because of the age of parts of the mine, is Fig. 2 orthodox in converting from a 3-wire, 3-phase primary to a 4-wire, 2-phase secondary current required for transformer-type welders? It will balance the load equally on the primary, we hope. —P.C.Z.

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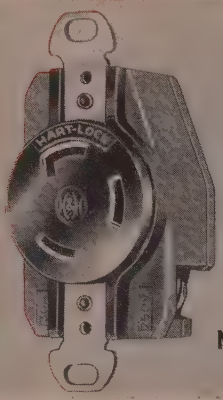

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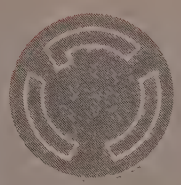

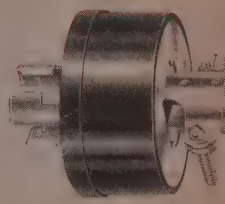

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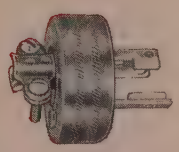

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Questions on the Code

Answered by:

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*

B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

Conductors in Multiple

Q. *On a new installation, feeders 300 and 500 MCM, 150-200 ft in length are pulled in underground to the main switch room, equally cut in length before fastening to the respective 3-pole switches.*

The transformer room is next. Overhead copper bars lead from the switch room to the transformer room, hanging overhead 10 ft above three transformers which are fastened to a concrete floor. Height of transformer units is 5 ft.

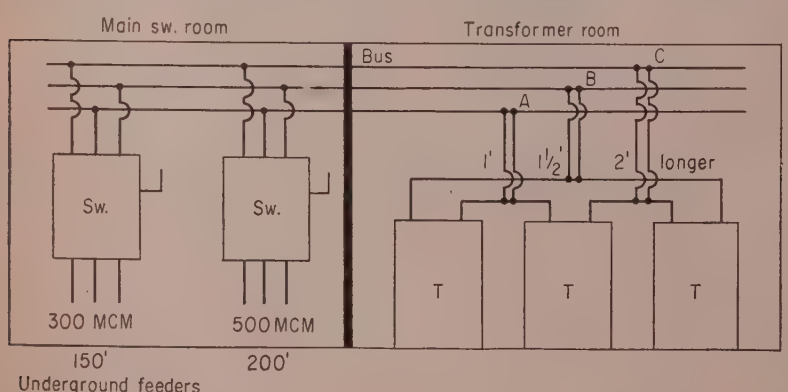
We want to connect the transformer secondary to copper bars above with four heavy clamps on each transformer unit. We shape the individual cables in one bunch and find the lengths are 1- 1½- and 2-ft difference.

Is this a code violation? If so, how would you equalize copper size in these cables from overhead down to the transformers lugs?—E.K.

A. I have endeavored to visualize the installation through the illustration shown below. In the absence of specific advice, I am assuming that the conductors, connecting each transformer phase terminal to the bus bar, are run in multiple. This appears to be correct in view of the size of the two secondary feeders. It therefore appears that the provisions of Section 310-10, which read as follows, applies:

"Conductors in sizes of 1/0 and larger may be run in multiple provided they are of the same length and have the same circular-mil area and type of insulation. Where conductors are run in multiple, they shall be arranged and terminate at both ends in such a manner to insure equal division of the total current between all conductors that are involved."

If the length of each conductor comprising the multiple assembly that connects each phase of the transformer to the bus bar is the same, it appears that the above quoted rule has been satisfied. I do not believe that the rule intends to require the multiple assembly of all phases to be of the same length. If such was intended, it would be very difficult to connect multiple conductors to the terminals of a large switch in view of the distance between such terminals. I am assuming that the difference in lengths which vary from 1 to 2 ft indicates that phase C is 1 ft longer than phase A, and B is ½ ft longer than phase A, if I understand your code question correctly. I do not believe there is any violation of Section 310-10—B.A.McD.—4/60/1



Service Entrance Conductors

Q. *In a 2-unit building of a low rent housing project with a limited and fixed electric load of less than 30 amps to each unit, plans and specifications call for the service to be three No. 6 RH conductors in 1¼-in. conduit from service head of proper height to a 2-gang meter trough. Located directly under the meter trough will be two weatherproof pull-out fuse disconnect switches approved for service entrance equipment, such switches to be fused at 40 amps, one switch for each unit. Running from each weatherproof switch will be a ¾-in. conduit to a distribution panel in each unit. The conductors in the conduit will be three No. 8 RH.*

Does the above meet the National Electrical Code requirement 230-41 which calls for service entrance conductors to be a minimum of No. 6?—M.W.

A. Yes. The 60-amp weatherproof switch for each unit located outside of the house under meter can be classed as the means of disconnect as the result of the definition of Service Equipment—Article 100, which states:

"The necessary equipment, usually consisting of circuit breaker or switch and fuses, and their accessories, located near point of entrance of supply conductors to a building and intended to constitute the main control and means of cut-off for the supply to that building."

The three No. 8 conductors running from the main service switch to the panel are feeders and not service entrance conductors. If fused at 40 amps they are properly protected, and adequate in size for the connected load. The three No. 6 RH conductors are adequate in size for the load to be served in the two units.—R.E.W.—4/60/2

Metering Equipment

Q. *Can the electric utility metering equipment with an ordinary outside weatherproof disconnect switch located 6 ft above ground level on a pole be installed in an outside location less than 25 ft from the loading rack of a gasoline bulk storage plant?—H.A.*

A. No, unless the code-enforcing authority gives special permission by judging otherwise, as is stated in Section 515-2(c), which reads:

"In outdoor locations, areas adjacent to loading racks or platforms, or to above ground tanks shall be considered to be Class I,

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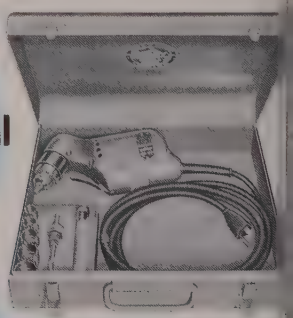

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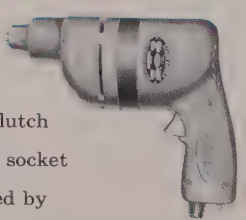

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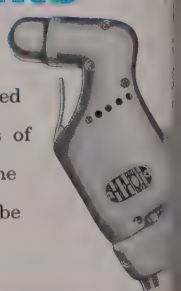

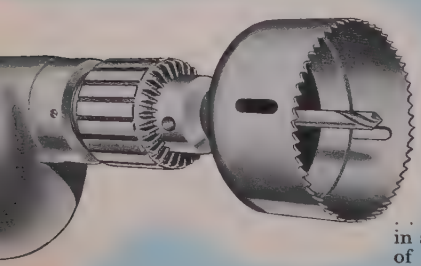

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Division 2 locations. Such areas shall be considered to extend 25 ft horizontally from such racks or tanks and upward from adjacent ground level to a height of 15 ft, unless the code enforcing authority judges otherwise."

Section 501-3 covers meters, instruments and relays. Therefore, metering equipment would have to conform to the above section of the Code as well as the disconnect switch being approved for Class 1, Div. 2 locations. — R.E.W. 4/60/3

Grounding Problems

Q. *In connection with the wiring diagram shown below, does the code require the neutral bus and the ground bus to be bonded together within the main switchboard? How do you determine the size of equipment ground for neutrals of dry-type transformers as shown?—D.S.*

A. It appears from your diagram that the service entering the building is 3-phase 4-wire, 480/277 volts, Wye, with the neutral conductor operating at 277 volts to ground, grounded as shown. Section 250-5 recommends such grounding when the voltage to ground does not exceed 300 volts. Our answer to your first question appears to be covered by Section 250-53, which reads as follows:

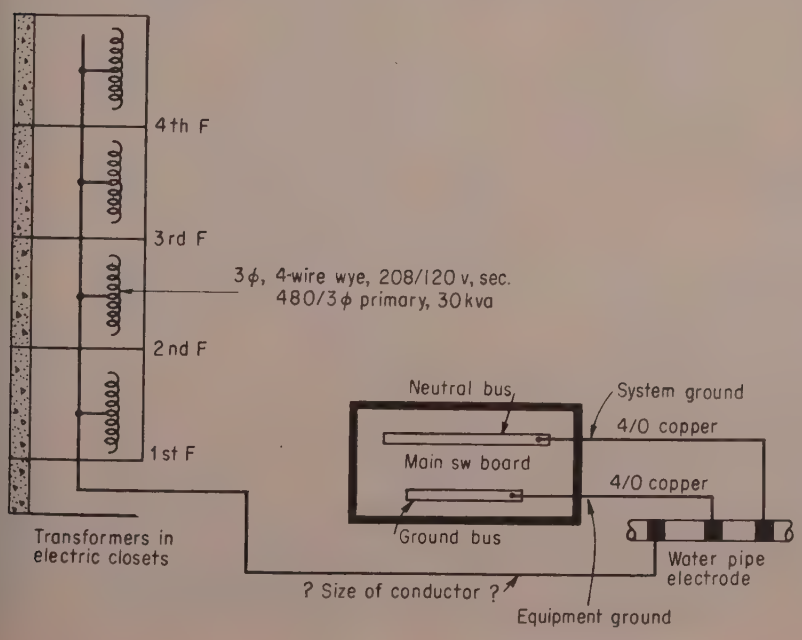
"Common Grounding Conductor. The grounding conductor for circuits may also be used for grounding equipment, conduit and other metal raceways or enclosures for conductors, including service conduit or cable sheath and service equipment."

This "may" rule denotes permission and therefore is not mandatory. As a result the two separate grounding conductors, No. 4/0 in size, could be run to the grounding electrode as shown on your diagram. This rule eliminates the occasion to run two separate grounding conductors, one for the system and the other for equipment, which could be a costly item when the grounding electrode is located remote from the service equipment. It could be costly, and at the same time not provide the degree of safety afforded by the use of a common grounding conductor. When the neutral bus and the metallic service equipment are bonded together, we eliminate the occasion for a fault current to travel over an equipment grounding conductor to the grounding electrode, and then back over a system grounding conductor to the neutral grounded conductor at the service. We actually tie them together at the electrode rather than at the service, and the impedance of a fault circuit will be increased in proportion to the distance of the electrode from the equipment.

If this concept of Section 250-53 is correct, why is this rule not covered as a mandatory provision? Why not substitute the word "shall" for "may"? Why not eliminate the unnecessary and questionable circuit provided by the two separate grounding conductors? One of the reasons appears to concern the provisions of Section 250-57 (b-2) which recognizes a separate grounding conductor for grounding fixed equipment. This rule may be applied where non-metallic systems of wiring are involved. It appears evident however that Section 250-53 could be made mandatory with exceptions for other rules which would be in conflict.

This subject is covered in considerable detail in an article titled "Grounding and the NEC" in November 1959 issue of E.C.&M. The author, Eustace C. Soares, is considered to be an authority on the subject of grounding. On the question under discussion, he comments as follows: "It is thus evident that Section 250-53, which permits the use of separate grounding conductors, might conflict with Section 250-51." The occasion for this comment is covered in detail in his article.

In reply to your second question, the provisions of Section 250-26 require the 120/208-volt, 3-phase 4-wire system, derived through each transformer, be grounded at the transformer, as the voltage to ground is 120 volts. In the absence of any exceptions to the general rules for grounding, it appears that the grounding of the isolated system must satisfy the pertinent rules of Article 250. As a result, the system ground and equipment could be interconnected at the transformer. Such an interconnection would provide a short and low impedance circuit for clearing a fault. When several transformers are connected to a common grounding electrode, as shown on the diagram, how do you compute the size of the common grounding conductor? The provisions of Section 250-94 cover the question by reference to Table 250-94 (a), which establishes a ratio between the service conductor and the grounding conductor. If the service derived through each transformer consists of No. 2 conductors, the grounding conductor could be No. 8 in size. When there are four transformers of the same rating as shown, would a No. 8 grounding conductor be of sufficient size to satisfy the grounding provisions for all of the transformers? Should the grounding conductor be equivalent to four No. 8 conductors on the basis of circular-mil area? Such questions do not appear to be covered by the code. It is quite evident however that there is a considerable distinction in hazard between isolated systems and those derived through distribution systems served by large transformers. In the case under discussion, the fault current would be limited by the protected 30-kva transformers. With a com-



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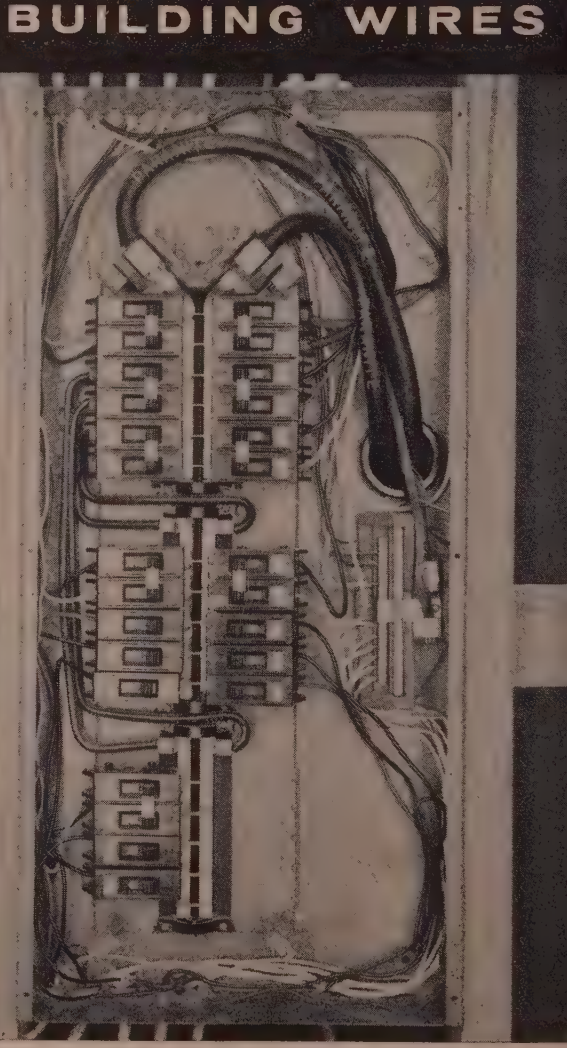

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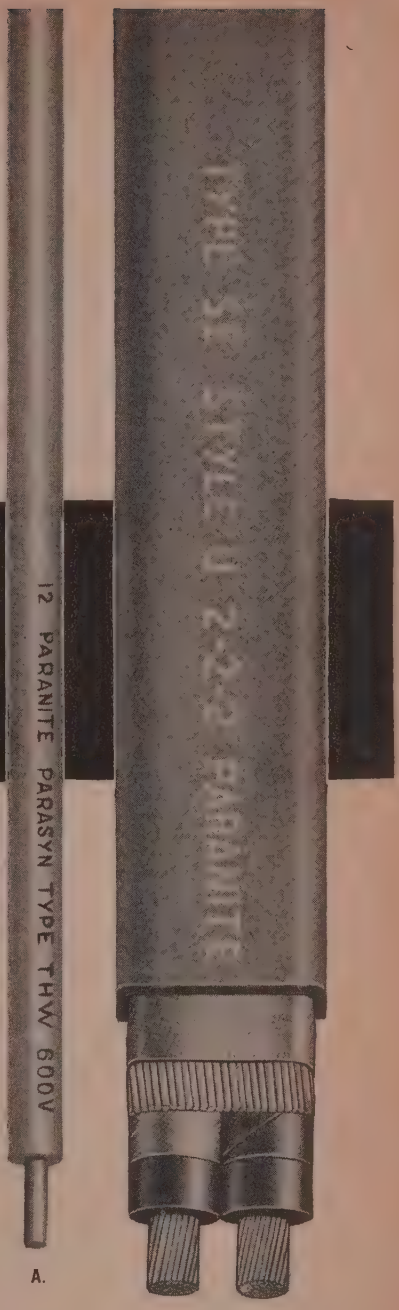

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B.

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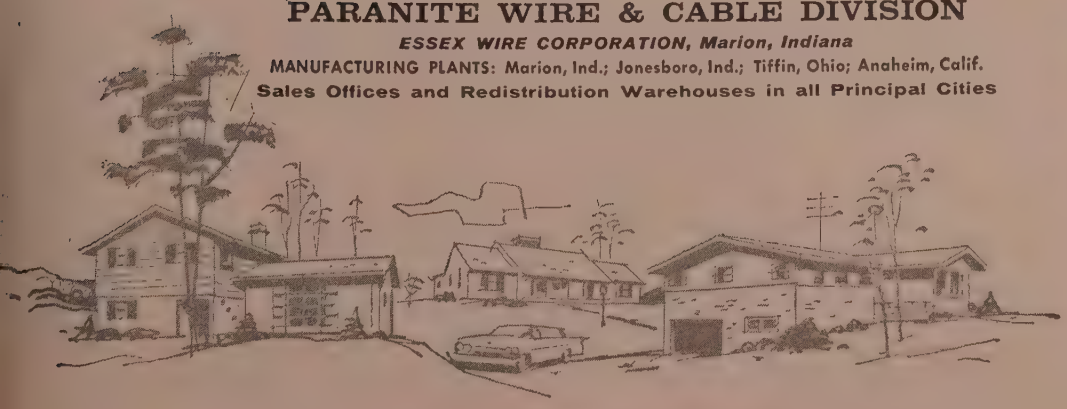


mon grounding conductor the fault, in the case where circuits are enclosed in metallic raceways, cables or other types of metal enclosures would be cleared without resort to the use of the grounding conductor. The isolated system is not directly exposed to the hazards of lightning or outside faults on the distribution system. In other words there is a distinction in hazard between the two systems which possibly deserves consideration for future code revision.

In the absence of specific rules covering your question, one may only express a personal opinion. On the installation shown on the diagram it appears that a No. 8 grounding conductor would satisfy, on the basis of comparison, the present code rules. This statement visualizes the fact that the transformers in question could be grounded to small water pipes provided the water piping system is made continuous by bonding all parts which are liable to be disconnected. Such a path to ground could be of higher impedance than that of a No. 8 conductor. According to the provisions of Section 250-92, such a size grounding conductor must be installed in conduit, electrical metallic tubing or protected by cable armor. The provisions of this section enter the picture, and it is quite possible that the grounding conductor should be No. 4 in size depending upon the nature of installation with respect to physical damage.—B.A.McD.—4/60/4

Clearance from Fence To Transformer Housing

Q. *Our company is in the process of preparing plans and specifications for a large addition to a manufacturing plant. The transformer station serving this plant is now located on a pole structure located at the rear of the existing plant. The new addition will be built where the transformer station is now located. When the new addition is built, it will be necessary and desirable that the transformer station be located on the roof of the new building. The building will be fireproof construction with a poured, lightweight concrete roof. The transformer station will consist of three 500-kva oil filled transformers. Primary voltage of 13.2 kv, secondary voltage to be 480/277. A reinforced concrete pad with retaining wall and drainage facilities will be specified as is required by Section 450-25. The roof of this building will be flat. Therefore, our specifications will call for a protective fence around the transformer station. Our question is, what clearance is required between the metal fence and the metal transformer cases.—N.E.C.*

A. From my search and knowledge of the National Electrical Code, your question is not specifically covered. Section 110-15 states in part:

"Working Space about Electrical Equipment. Suitable working space shall be provided and maintained about all electrical equipment." And a fine print note refers to Article 710 for voltages higher than 600.

Section 710-31 states:

"Enclosure for Electrical Installations. Electrical installations in a vault, room, closet or in an area surrounded by a wall, screen or fence, access to which is controlled by lock and key or other approved means, are considered to be accessible to qualified persons only. The type of enclosure used in a given case shall be designed and constructed according to the nature and degree of the hazard(s) associated with the installation. Article 450 covers minimum construction requirements for oil-filled transformer vaults."

In checking with recognized engineers and power distributors in Tennessee, I find their recommendations to be a minimum of 5 ft clearance from fence to transformer housing and when space is not a problem, more clearance than 5 ft is provided.—R.E.W.—4/60/5

Green Conductors For Grounding

Q. *Is it the intention of the code to prohibit the use of the green conductor in control cable for other than equipment ground? —R.E.O.*

A. The provisions of Section 210-5, which pertains to branch circuits, reads as follows:

"Any conductor intended solely for grounding purposes shall be identified by a green color unless it be bare. Conductors having a green covering shall not be used for other than grounding purposes."

Section 250-57 also requires a covered conductor, used for grounding fixed equipment to have a green color finish.

Section 250-59 requires a covered grounding conductor in a cable assembly to have a green color finish.

Section 400-14, which concerns flexible cords also requires a covered grounding conductor in a cord assembly to have a green color finish. Sections 665-22 and 670-23 have similar provisions for the grounding conductor.

It appears quite evident from the foregoing that the color green has been reserved for the purpose of identification of a grounding conductor; and such an identified conductor cannot be used as a normal current-carrying conductor. The provisions of Section 400-14, concerning cords, first appeared in the 1953 edition of the code. It was a source of considerable concern to the manufacturer of cables and cords. As a result a fine print note, similar to the one which appears in the 1956 Code, was inserted under this section. It reads as follows:

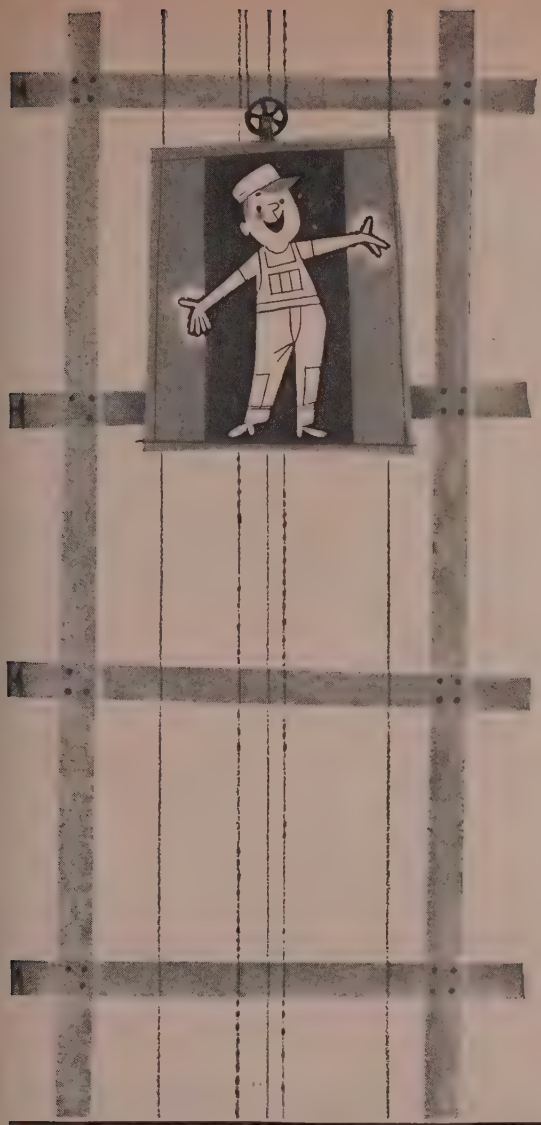
"Until January 1, 1958, this shall not be construed as prohibiting the use of a conductor having a green finish as an ungrounded circuit conductor in cords having no conductor used as a grounding conductor, provided the green conductor is re-identified at the terminal ends."

This fine print note has been deleted from the 1959 edition of the code. At a recent sectional meeting of the Eastern Section, International Association of Electrical Inspectors, this question as it concerns the wiring of portable equipment, such as radios and television sets was discussed. Such appliances do have green colored insulated conductors used for normal circuit wiring. While such appliances do not appear to be covered by the code at the present time, the thought was expressed by a reliable authority that such procedure will be eliminated in the future.

A brief summary of the foregoing indicates that a green conductor in a control cable may only be used as a grounding conductor. —B.A.McD.—4/60/6

Grounding Conductor

Q. *What size grounding conductor is required for the grounding of gasoline tanks of 20,000-gal capacity used in a bulk storage plant consisting of six tanks, each tank being 25 ft distance from any other tank with a loading rack adjacent to the tank area for filling delivery trucks?—W.B.R.*



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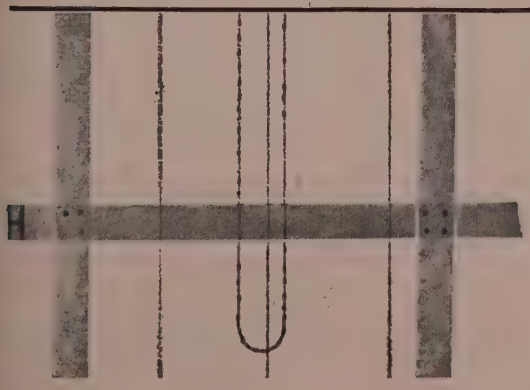

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A. Article 515 of the NEC covers bulk tank storage and grounding of such electrical equipment is covered by Article 250. In addition to the above, the inspection manual of the NFPA under Static Electricity and Lightning Protection requires grounding. The minimum size ground wire is a No. 4 copper conductor. The usual arrangement for grounding bulk plants such as you describe of which I have knowledge is the use of the minimum No. 4 copper conductor from each tank to a driven or other approved grounding electrode at each tank with all electrodes bonded together with the minimum No. 4 copper conductor in addition to the grounding of the metallic raceways and all non-current carrying metallic portions of electric equipment as is required by Article 515 of the 1959 NEC. Provisions shall also be made for bonding the tank truck or vehicle to the filling racks during loading operations to minimize the danger of ignition by static sparks. All grounding electrodes on the premises shall be bonded together with at least a No. 4 copper conductor and in many cases larger where such grounding conductor may be subject to mechanical injury.—R.E.W.—4/60/7

Motor and Control Disconnects

Q. *Illustration shows a lighting and appliance branch circuit panelboard containing* 12 *20-amp, single phase circuits for lighting, and five* 20*-amp,* 3*-pole circuits for the five* 1*-hp motors shown. The service is* 120/208*-volt,* 3*-phase,* 4*-wire Wye. The motor starters are across-the-line magnetic. The panelboard is provided with a lock.*

1. *May the circuit breakers within the panelboard serve as disconnects for the motor starters?*

2. *May the lock on the door of the panelboard serve as "lock-out" means if the motors are more than* 50 *ft or out of sight?*

3. *You will notice that the starters are grouped next to the panelboard.*

4. *This has been a question of controversy over the years.—D.S.*

A. According to the provisions of Section 430-109 (b), a circuit breaker, or a general-use switch having a rating not less than twice the full-load current rating of the motor may serve as the disconnecting means for a motor rated 2 hp or less and its controller. This code rule is contingent on other rules covering disconnecting means such as the following:

Section 430-103 requires the disconnecting means to disconnect both the motor and the controller.

Section 430-104 requires it to plainly indicate whether it is in an open or closed position.

Section 430-107 requires it to be readily accessible.

Section 430-102 requires it to be located in sight from the controller location or be arranged to be locked in the open position.

Section 430-4. The term "in sight from" means that the equipment must be visible and not more than 50 ft distant.

Section 430-86 requires "Where a motor and the driven machinery are not in sight from the controller location, the controller shall comply with one of the following conditions:

"(a) The controller or its disconnecting means is capable of being locked in the open position (unless special permission is given by the authority enforcing this code)." The parenthetic clause is new in the 1959 Code.

"(b) A manually operable switch, which will prevent the starting of the motor, is placed within sight from the motor location. This switch may be placed in the control circuit of the magnetic controller."

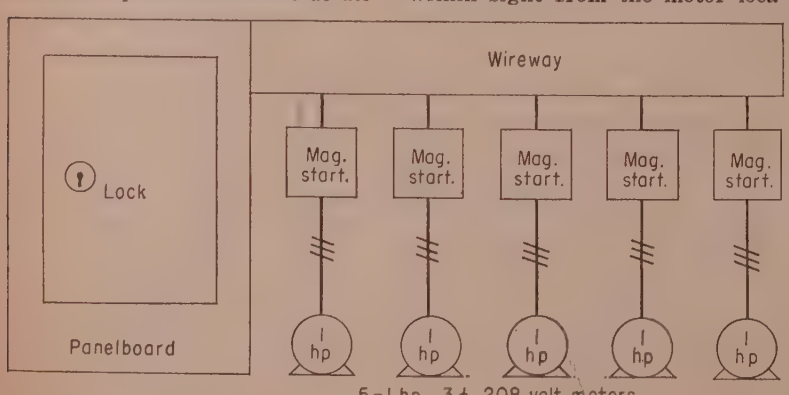
Applying the foregoing rules to your example, we find that the motor branch-circuit overcurrent device is a circuit breaker, which qualifies as a disconnecting means for a controller and the small 1-hp motors. (This may not be true for larger motors.) It disconnects both the controller and its motor. It is readily accessible. It is marked to show that it is in an open or closed position. It is located immediately adjacent to the controller. All of these rules appear to be properly satisfied. There is, however, a question with respect to Section 430-86. If the motors are "in sight from" the controller location there appears to be no code violation.

If the motors are not visible from the controller location, regardless of the distance, their controls or disconnects must be capable of being locked in the open position.

While some authorities have accepted the lock on the door of a panelboard as satisfying these "lockout" requirements, I do not believe such procedure will provide an adequate safeguard of the personal injury hazard involved. The new clause appearing under Section 430-86 which reads as follows is intriguing: "unless special permission is given by the authority enforcing this code."

In the absence of authoritative advice with respect to this new clause, one may only speculate with respect to its application to locks on panelboard doors. Several years ago I investigated an experience with a panelboard containing pullout switches, rated in horsepower, which served several motors. The electrician working on a motor pulled the switch out and, in order to avoid an accident, took it with him to the motor. He felt perfectly safe that the circuit would remain de-energized. Another electrician came along, unlocked the panelboard door, removed another pullout and when he replaced it, he inadvertently inserted it in the circuit on which the first electrician was working. Accidents of this nature are probable when disconnects, in the form of circuit breakers or switches, installed in a locked panelboard are accepted as satisfying the requirement "locked in the open position."

Assuming that the motors in question are out of sight of the controller location, and the individual control or the individual disconnect cannot be locked in the



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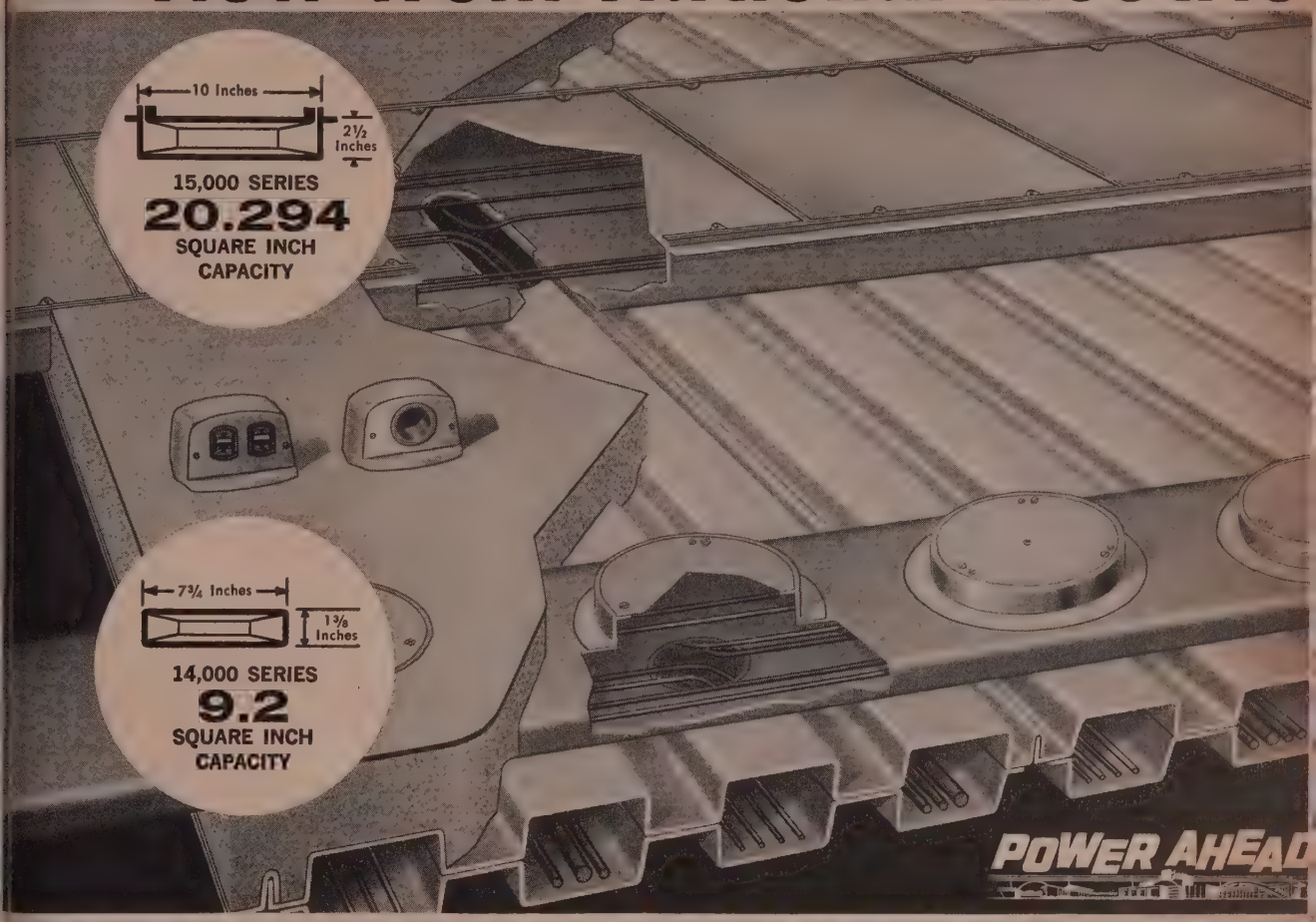

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open position, I believe that an individual switch should be installed at each motor, as covered by Section 430-86. It is significant to note in this respect that a new rule under Section 430-109 recognizes the use of snap switches as disconnects for ac motors rated 2 hp or less under the conditions specified. For the protection of the maintenance electrician, such a small investment is more than justified.—B.A.McD.—4/60/8

Disconnecting Means

Q. *Can a fuse disconnect switch of 250 volts consisting of an assembly with a main pull-out and 12 plug fuse holders be used as the disconnect means for six 230-volt circuits of electric heating cable imbedded in plaster?—M.W.*

A. No, with the following exception:

If an approved thermostat that breaks both ungrounded conductors is used, or a double pole switch of adequate size that disconnects both ungrounded conductors of the branch circuit is used, approval can be given. The following references are made in connection with your question: Sections 422-14, 422-16, 422-18, 422-29 and the 1959 National Electrical Code, which are as follows:

"422-14 Disconnecting Means. Each appliance shall be provided with a means for disconnection from all ungrounded conductors.

"422-16. Disconnection of Stationary Appliances.

(a) For stationary appliances rated at not over 300 volt-amperes or ⅛ hp, the branch-circuit overcurrent device may serve as the disconnecting means.

(b) For stationary appliances of greater rating the branch-circuit switch or circuit-breaker may, where readily accessible to the user of the appliance, serve as the disconnecting means.

"422-18. Switch and Circuit Breaker to Be Indicating. Switches and circuit breakers used as disconnecting means shall be of the indicating type.

"422-29. Controllers and Disconnecting Means.

"(a) Thermostats and thermostatically controlled switching devices which indicate an 'off' position and which interrupt line current shall open simultaneously all ungrounded conductors in the 'off' position.

"(b) Thermostats and thermostatically controlled switching devices which do not have 'on' or 'off' positions are not required to open all ungrounded conductors.

"(See Sections 422-14, 422-16, and 422-18 for disconnecting means for stationary appliances.)

"(c) Switching devices consisting of combined thermostats and manually controlled switches which serve both as controllers and disconnecting means shall:

"(1) Open regardless of temperature all ungrounded conductors when manually placed in the 'off' position;

"(2) Be so designed that the circuit cannot be energized automatically after the device has been manually placed in the 'off' position."—R.E.W.—4/60/9

Comment

In answer to a question concerning aluminum conduit (Feb. 1960, page 168), B.Z.S. stated, in part:

"In general, if a wiring system (aluminum) . . . is to be installed, it should be planned to use aluminum throughout for all fittings, cabinets, etc. Not only is this necessary to eliminate possible heating, but also to prevent the possibility of galvanic action due to the presence of dissimilar metals (Section 346-1)."

The last sentence of Section 346-1 states:

"If practicable, the use of dissimilar metals in contact anywhere in the system shall be avoided to eliminate the possibility of galvanic action."

R. F. Becker, Kaiser Aluminum & Chemical Sales, Inc. dissents:

"If this statement as to use of dissimilar metals were to be strictly enforced, it would certainly forbid connecting bare copper ground wire to steel switch cabinets and other steel equipment, since the galvanic difference between copper and steel is as great or greater than the difference between the alloy used for aluminum conduit and steel.

"Entirely too many articles have touched briefly on this subject of dissimilar metals without going thoroughly into the subject to explain that while it is possible, the likelihood of such corrosion is not a problem. Should the other necessary elements be present in order to create galvanic corrosion, such as constant moisture and an electrolyte, the steel materials in the area are more likely to rust away than to form a galvanic cell."

Grounding

Q. *Is it a requirement that the the metal pole or standard of a yard light be grounded where the system of wiring is underground feeder cable (non-metallic without ground)? If so, what method of grounding may be used?—J.M.W.*

A. Yes. It is a requirement that the metal pole or standard of a yard light be grounded. This requirement is covered under Article 250, and can be classed as either enclosure grounding or equipment grounding. In all probability, conductors would be run within the metal pole or standard and would be covered by Section 250-33 which states:

"Other Conductor Enclosures. Metal enclosures for conductors shall be grounded, except they need not be grounded in runs of less than 25 ft which are free from probable contact with ground, grounded metal, metal lath or conductive thermal insulation and which, where within reach from grounded surfaces, are guarded against contact by persons."

Section 250-42, Fixed Equipment, states in part:

"Under any of the following conditions, exposed, non-current-carrying metal parts of fixed equipment, which are liable to become energized, shall be grounded:

"(b) Where equipment is located in a wet location and is not isolated;

"(c) Where equipment is located within reach of a person who can make contact with any grounded surface or object;

"(d) Where equipment is located within reach of a person standing on the ground."

In answer to the second part of your question, the method, Section 250-57 states:

"Fixed Equipment.

"(a) Metal boxes, and fittings, and non-current-carrying metal parts of other fixed equipment, where metallically connected to grounded cable armor or metal raceway, are considered to be grounded by such connection.

"(b) Where not so connected they may be grounded in one of the following ways:

"(1) By a grounding conductor run with circuit conductors; this conductor may be uninsulated, but where it is provided with an individual covering, the covering shall be finished to show a green color.

"(2) By a separate grounding conductor installed the same as a grounding conductor for conduit and the like;

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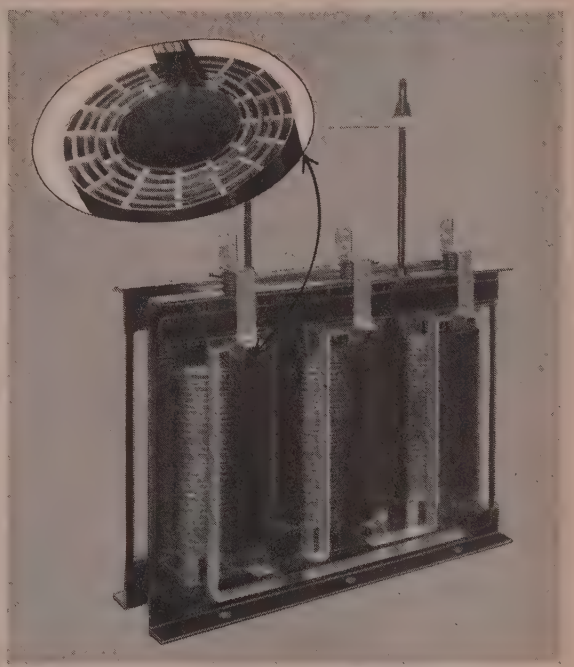

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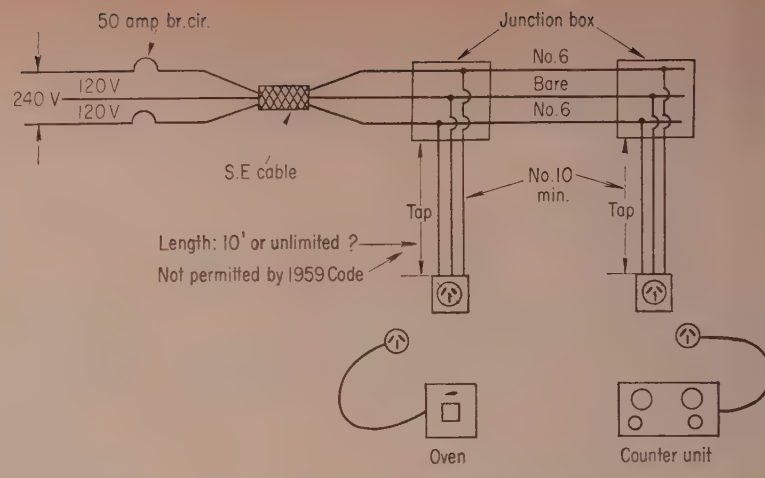
"(3) By special permission, other means for grounding fixed equipment may be used."

Number (1) of the above Section would not apply if uninsulated although this is a grounding conductor but not in conduit. It is my opinion that the grounding conductor should be insulated and approved for direct burial when used for this purpose.—R.E.W.—4/60/10



Wiring Range Components

Q. *The question has to do with code requirements in the wiring for electric ovens and counter-mounted cooking units. We note in the* 1959 *Advance Reports, paragraph* 210-9c, *Exception* 2-d, *that tap conductors "from* 50-*amp branch circuits shall not exceed* 18 *in. in length, except where longer conductors are required for installation or servicing and in no case to exceed* 10 *ft."*

Our interest in the rule, as stated in the advance reports (and assuming the final code printing will be the same), comes from one of the provisions of our promotional appliance wiring plan. To promote the use of electric ranges, dryers, and water heaters, our company provides the circuit facilities to supply them when proper facilities do not already exist in the user's home. Our policy stipulates that we will install one circuit to a range. Since total annual installations run into the thousands the furnishing of two circuits for the divided units would seriously affect our costs. We have been wondering if the new code provision cited might permit running a 50-*amp circuit to a junction box near the two units and reducing wire size for the final runs to the separated components.—L.A.W.*

A. For the convenience of our readers the provisions of section 210-9(c), as covered in the advance reports covering the 1959 Code read as follows:

"Section 210-9 Conductors.

"(a) Carrying Capacity. Shall have a carrying capacity of not less than the rating of the branch circuit and not less than the maximum load to be served."

An exception is made to this general rule under Section 210-9(c), Exception 2-d, which reads as follows:

"(d) Tap conductors supplying electric ranges, wall-mounted electric ovens and counter-mounted electric cooking units from 50-amp branch circuits shall not exceed 18 in. in length except where longer conductors are required for installation or servicing and in no case to exceed 10 ft."

On June 2, 1959, the Electrical Committee, NFPA, convened in Atlantic City, and after a brief discussion, the above wording was revised unanimously to eliminate the reference to 18 in. and 10 ft. If this action was accepted by the correlating committee, the new wording would read somewhat as follows:

"(d) Tap conductors supplying electric ranges, wall-mounted electric ovens and counter-mounted electric cooking units from 50-amp branch circuits shall not be longer than required for installation or servicing."

Since I am not advised with respect to the action taken by the correlating committee, I prefer to answer your question on the basis of the advance reports, with the thought that the 10-ft tap limitation, if deleted, extends the application. The answer to your question appears to center around the phrase "longer conductors are required for installation and servicing." The word "installation" could be interpreted to permit the installation of a 50-amp branch circuit with taps running to electric ranges, wall-mounted ovens and counter-mounted cooking units, and I suspect such procedure is intended. Illustration covers an installation which I believe is recognized by the 1959 Code. Copy of our comment is being forwarded to Mr. H. H. Watson, Chairman of Panel No. 2, for his authoritative advice on the following questions.

Have the 18-in. and 10-ft tap limitations been deleted in Section 210-9(c), Exception 2(d)?

Is the installation shown by illustration recognized by the 195 Code?

When these questions are an swered, I will be able to commen with a background of authority. I the meantime, it appears to m that your suggestion for procedur will satisfy the 1959 Code.

Reference to the 1959 Code show that the controversial word "instal lation" which appeared in Sectio 210-9(c), Exception 2-d of the Ad vance Reports has been deleted, an doe not appear in the 1959 editio of the code. As a result the tap shown by illustration are in viola tion of the code, and the branc circuit wiring consisting of tw No. 6 and a bare No. 8 must be ru direct to each receptacle outlet This observation is verified by H. H Watson by the following comment

"The intent of the new code is t prohibit the reduction in branch circuit conductor size when mor than one appliance is served. Th only reduction permitted is in th oven or cooking unit leads (or tap and then only long enough fo servicing."

It is also significant to note tha all reference with respect to th length of the tap or the lead ha been deleted from the 1959 Code In view of the foregoing, it appear to me that a separate circuit run t each outlet would satisfy the ecc nomic considerations involved. Th use of conventional wiring method coupled with smaller conducto sizes, would compete favorably wit a 50-amp branch circuit. Contrac tors have advised me accordingly However, selection of a 50-amp cir cuit or two or more smaller circuit rests with the installer.

Note: Section 210-9 as mentione in this code comment appears i the new 1959 Code as Section 210 19.—B.A.McD.—4/60/11

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T 170	1 to 12 on-off per day	SPST DPST SPDT	125/250 volts	35	Same as above, plus skips operation on selected days, automatically.
T 180	1 to 12 on-off per day	SPST SPDT	125/250 volts	35	Each on-off period independently adjustable from 5 to 60 minutes.
T 960	1 to 96 on-off per day	SPST SPDT	125/250 volts	20/15	Each on-off period in 15 minute units. Trippers permanently attached to dial.
C 8300	1 to 12 on-off per 12 minutes	SPST	125 volts	15	Timings from 10 seconds to 11 minute, 50 second periods.
T 500-R	1 to 12 on-off per day	SPST DPST	125/250 volts	55	Heavy duty standard ON-OFF switch. Up to 27,500 watts. Also available with "SKIPPER" feature.
T-1100	1 on -off operation per day	SPST	125 volts	15	Flush wall mounted standard ON-OFF switch to central circuits in house or store. (LAMP • LYTER)

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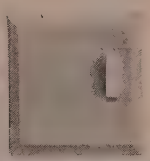

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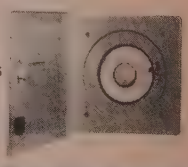

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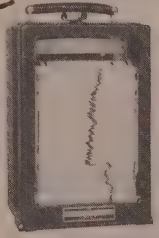

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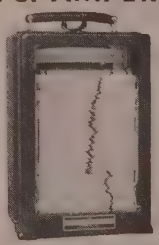

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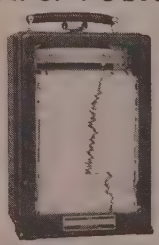

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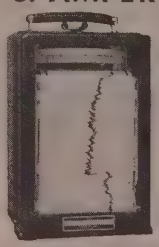

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(FROM PAGE 111)

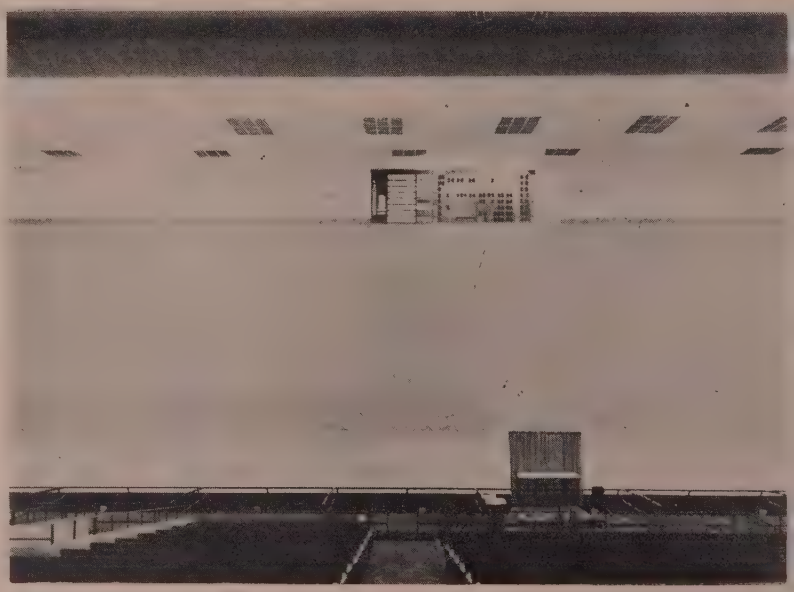
trial type of direct lighting reflectors, installed overhead on the ceiling. With this system, the pelota (ball) was often in shadow, and difficult for either the players or the spectators to follow. For the players, another discomfort factor was also noted. When the pelota was in play, off the three walls, the overhead system of direct lighting reflectors was glaring, with the brightly lighted units frequently in their field of view.

The new lighting system consists of a row of specially designed borderlights, and all ceiling-mounted luminaires have been eliminated from the ceiling over the playing court. The new border lights run for the court's full 180-ft length, and are mounted at a height of 45 ft from the court floor recessed in the ceiling at the front (spectators) side of the playing court. Thus the lighting source is now located behind the players, and the luminaires completely concealed from the view of the spectators.

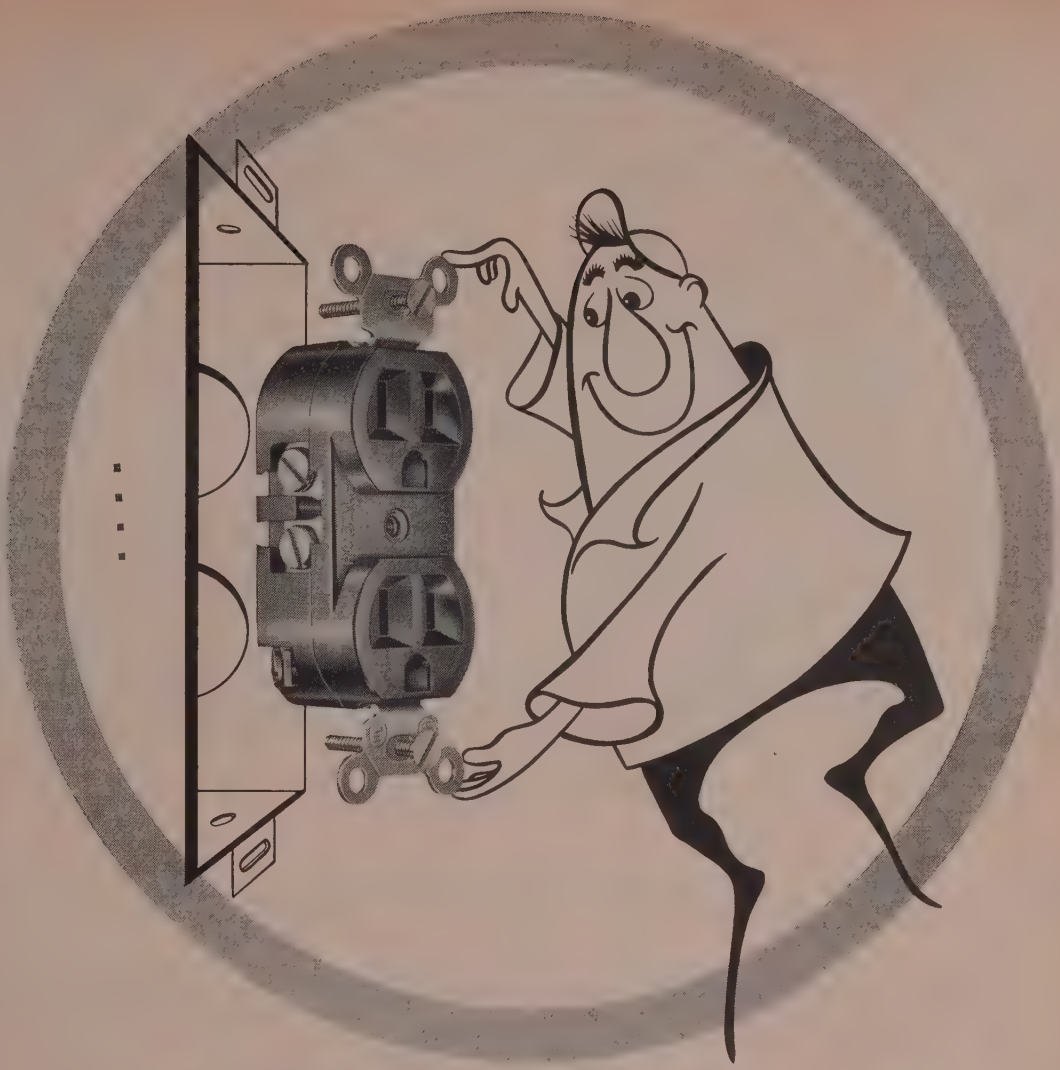
The new borderlight consists of 36 shallow fluorescent luminaires, each 48¼ in. sq by 6 in. deep, and each unit equipped with eight F48PG17/CW Power Groove fluorescent lamps. These luminaires are installed at an angle of 67 degrees with the vertical in a ceiling opening measuring 55 in. wide, and located directly above the outside edge of the playing court. The lamps are positioned on 6-in. centers in each luminaire, in individual polished Alzak reflectors. The luminaire housing is made of 18-gauge steel, and finished baked white enamel inside and outside. Initial light output of each luminaire is 55,200 lumens, and the initial lighting level over the entire 8640 sq ft court area was 90 footcandles, uniformly distributed.

Lighting maintenance has been planned for on a simplified basis. The luminaires are each yoke-mounted in a 2-in. by ½-in. by $\frac{5}{16}$-in. steel channel yoke, which permits a luminaire to be rotated about its center axis. The normal position for operation is at an angle of 67 degrees from the vertical, and units can be rotated to a convenient position for relamping from above the ceiling. Stops are provided all along the retaining border to assure that units will be repositioned accurately after maintenance.

This unique custom-designed lighting system was planned by E. W. Lampert, chief engineer of the Frink Corporation, whose firm made and supplied the luminaires. The luminaires, and the electrical system required, were installed by P & G Electric Company, electrical contractors of Dania, Fla.



SPECTATORS' VIEW of Jai Alai court shows rear wall, floor, and two end walls (not visible in this photo). Borderlight is completely shielded, as shown. Scoreboard at top of rear wall is separately lighted by incandescent spotlights recessed in ceiling over the board.



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Electric Heat Exposition Attracts 2000

The outstanding success of NEMA's National Electric House Heating Exposition and Symposium in Chicago attests to the rapid progress of electric heat in its bid to become a major segment of the electrical industry.

MORE than 2000 electrical industry personnel attended the National Electric House Heating Exposition and Symposium on March 21-23 at Chicago's Sherman Hotel, under the sponsorship of the Electric House Heating Equipment Section of the National Electrical Manufacturers Assn.

Electrical contractors, utility personnel, manufacturers, engineers, and others heard more than 50 representatives of the electric heating industry present up-to-date information on designing, promoting, selling and installing heating equipment.

An industry luncheon for all registrants featured an address by Joseph F. Miller, NEMA's managing director, followed by a report from W. Beverley Mason, Jr., assistant commissioner for technical standards, Federal Housing Administration. Miller recounted the enormous growth experienced by the electrical industry, discussed the many contributions of electricity to modern comfortable living, and expressed the hope that power networks would soon begin to "bring about through their crossing of national boundaries a greater understanding among nations."

Mason, explaining FHA's attitudes on electric heat, forecast a growing liberalization of its standards as operating costs become lower and as public acceptance grows, which should result in an increasing availability of electrically heated homes for lower-income families seeking FHA mortgages.

In his remarks opening the general session, C. F. Kreiser, general sales manager of the Edwin L. Wiegand Co. and chairman of the Electric House Heating Equipment Section of NEMA, emphasized the importance of electric heating to the continued growth of the electric utility and to the maintenance of low energy costs, and its role in avoiding the many penalties of industry stagnation. Others having a great stake in electric heating, he said, are the home builders, just beginning to realize the possible rapid obsolescence of homes using fuel-fired heating; the electrical contractors, who stand to get a much higher percentage of the builder's dollar; electrical manufacturers, whose electrical appliances will surely show increased use in the all-electric home; and the electrical supplier, whose wiring equipment sales must increase accordingly.

Following is a summary of significant points brought out in the exposition's general sessions and seminars.

Marketing Potential and Promotion

R. W. Smith, Pennsylvania Electric Co. and Metropolitan Edison Co.—How can a utility best promote electric heat? It must first establish a simple rate so that both the customer and installing contractor can understand it, then establish a clear-cut policy—a set of ground rules as to quality of equipment, installation, and performance. It must stand ready to check each installation. Design principles should be set forth clearly and brought home with well planned basic sales training. Finally, incentives should be offered to employes who install electric heat in their homes. A good leader is a good example.

Nile W. Stiffler, Indiana & Michigan Electric Co.—Every existing home is a potential customer for electric heating. Locating the prospect is the first job, and it should be done by teamwork involving the utility, the manufacturer, the distributor, the contractor, and the satisfied user. Personal contact with customers known to be planning home improvements is a must. They are people; every purchase they make means just one thing—someone has sold them on the personal benefits or comfort of each item.

C. E. Anderson, Virginia Electric and Power Co. — Supplementary and auxiliary heat form a large part of the utility's load-building potential. Every home now heated by fuel needs at least 2 kw of S & A electric heat to make it fully comfortable and functional. The load to be expected from supplementary heating ranges from 90 to 750 kwhrs per year per customer; auxiliary heating, from 500 to 1300 kwhrs. Ground rules must be set with respect to insulation, controls, and types of equipment suitable for each job. The greatest selling factor is to talk positively and often about electric heat, using all available media.

The Electrical Contractor

Alfred C. Sangster, Detroit Edison Co.—While the distributor must act as a bank, loan office, and counselor for the electrical contractor, the contractor is the key man. He must be trained to make equipment layouts and heat loss calculations. He very well could be the prime contractor in the space heating project, allying himself with a good insulation man. The aim is complete customer satisfaction.

F. E. Keith, Keith Electric Co., DesMoines, Ia. — The electrical contractor in his approach to electric heat must place less dependence upon competitive bidding where price is king; he must aim at developing business at a profit. If he is not a good salesman, he should hire a salesman to get the business. He must obtain assistance in estimating, financing, job management, accounting, and purchasing. The NECA Contractor Development Program has been instituted to provide management

guidance which will make the contractor a better business man. Selling his services is *the* way for industry to grow and prosper.

Charles P. Bobe, C. P. Bobe Company, St. Louis, Mo.—The electrical contractor is the only one who can provide the engineering services, the material, the installation, a performance guarantee, and servicing of electric heat jobs. Electric heat must therefore be at all times a part of the electrical specifications.

Charles Hart, *Qualified Contractor*—The electrical contractor must become a heating engineer; he must be completely familiar with all types of insulation and insulating techniques. He must get to know all types of electric heating equipment and controls; he must know who and what his competition is. He can do this most effectively by reading promotion and technical information and by attending industry meetings and electric heat training courses.

Joseph Felber, National Electrical Contractors Assn. — Today 70% of the electric space heating jobs are channeled through the electrical contractor. The other 30% is an acute industry problem and represents a grave danger to electric heat's progress. It cannot be sold as a plug-in appliance to merchandisers having no technical knowledge and little interest beyond the time of the sale. Electric heating is only as good as its installation.

Selling

Phil M. Furbay, Furbay Electric Supply Co., Canton, Ohio—Electric heating can be sold on its own merits. The distributor must ally himself with the installing contractors in offering the user one concise answer to the question of installed cost. He must set up a department with a well qualified man added to the sales staff to teach his other men so they in turn can teach the contractor. This means using profits from the existing established business until the new venture is self-sufficient. Every distributor should be in the heating field to be progressive in the industry and a leader among his customers.

H. G. Blumberg, Cadillac Electric Supply Co., Detroit—The electrical distributor cannot afford to lose the electric heating market. New products or services must be found to increase the narrowing avenues of promotional and sales efforts. Too many lucrative markets have been lost in the past because they were ignored in their infancy. Electric heat is probably the greatest new market since the advent of fluorescent lighting. Distributors must display increased awareness of this important market; other industries will not sit idly by and watch it slip through their fingers without a battle.

W. C. Wallis, Southern Supply Co., Jackson, Tenn.—Merchandising electric heat is a team job involving the manufacturer, the utility, the distributor and the contractor. The distributor is an all-important link in this chain. He is equipped to sell. He is the link between the manufacturer and the contractor; and he carries in stock the necessary wiring materials to install the equipment. Electric heat is not an over-the-counter item. It must be properly engineered and installed for customer satisfaction.

Joseph A. Pape, Commonwealth Edison Co.—People are always interested in something new and better, but real salesmanship is needed to convert them to buyers of electric heat. The salesman must know its advantages. He must be able to show the many benefits of room-by-control. Testimonials will help to bring home the savings due to cleanliness of operation. Electric heat has important economy features which must be ferreted out and detailed. Certain advantages will be more important than others to any specific prospect. The salesman must find out what they are and make his major effort in these directions. After the job is sold, he must follow up and make sure it is installed properly.

Technology

R. H. Luscombe, Penn Controls, Inc.—Electric heat has provided the homeowner with higher and more uniform humidity levels. Complaints of too-low humidities are rare. The too-high humidities occasionally reported can be corrected by closer control of living habits which produce excess moisture and by proper use of ventilating fans in moisture-producing areas. Humidistats connected to ventilating fans are effective when set at 35% through the worst part of the winter and above 90% during the summer, spring and fall.

W. J. Novak, *Electrical Construction and Maintenance* — Investigation of basement and crawl-space temperatures and heat losses is important for correct evaluation of floor losses over unheated spaces and for the proper design of a heating system for the below-floor space. Since heat loss from these areas is not directly proportional to outdoor temperatures and degree-days, other means must be used to determine heat losses and estimate costs. Available data on ground temperatures adjacent to basement walls and floors may be used to advantage in such determinations.

Robert M. Wood, Ebasco Services Inc.—While residential space heating may not balance specific utility distribution lines serving air conditioning loads, it will have an advantageous effect on the equally important transmission and generation system. Due to the heavy insulation in most electrically heated houses, peak demand usually lags lowest outdoor temperatures, occurring at 7 or 8 o'clock in the morning. The potential energy sales of electric heating justify investment in new highly efficient generating stations, which will cut overall operating costs. As the electric heating load grows, we can expect a gradual decline in investment cost per kw. Utilities are finding that the best course of action is to get on with the job and solve the problems as they come.

Leland Olds, Energy Research Associates—Electric rates should be set so as to make all-electric homes and farms a must, modern research and technology then being applied to achieve low costs with the increased energy usage which will make the chosen price feasible. A realistic attempt to capture the space-heating market will offer all-electric schedules with final incremental rates ranging from 1.5 cents per kwhr down.

J. A. Rodgers Jr., White-Rodgers Co.—The two basic types of wall thermostats use either bimetal elements or liquid expansion sensing elements. Somewhat closer control is obtained by the latter, although built-in anticipation in the former narrows or closes the gap. Whether the sensing element is exposed or enclosed will affect control, the former being desirable when used with highly radiant heating systems.

Patrick E. McCaughey, Wilcolator Co.—Both wall-mounted and built-in thermostats properly applied will do a good job. Built-in thermostats are the liquid expansion type using a bulb placed in position to sense the temperature to be controlled, usually apart from the switch and adjustment

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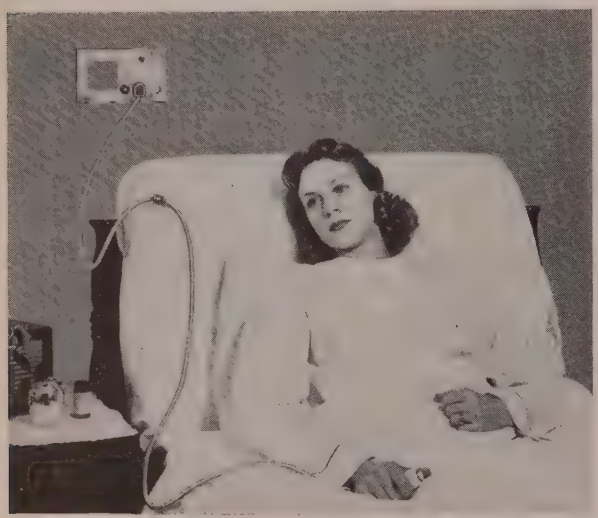

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dial. Built into the heater, they are usually capable of detecting downdrafts from walls or windows as they occur.

R. L. Boyd, Edwin L. Wiegand Co.—With an increasing number of central electric furnaces appearing on the market, a choice must be made between a central unit or individual room units. Where and when each is to be used must be determined by considering the advantages and disadvantages of each. The predominance of either type will depend on what the public buys, and what he buys will depend on what is sold. Deciding what the public wants and then selling the benefits of the chosen system, designed for maximum quality, will be the influencing factor.

Industry Standards

R. D. Graham, General Electric Co.—NEMA's new electric space heating equipment standards are of extreme importance to all segments of the industry. They define the product as to nomenclature, composition, construction, dimensions, safety, operation, performance, quality, and rating. It is important that all distributors, contractors, architects, engineers, inspectors, utilities, and consumers insist that these standards be met by the equipment they use.

Lowell R. Mast, Electromode, Div. of Commercial Controls Corp. —Where this industry goes from here will depend on how close we adhere to the old-fashioned virtue of honesty. Without widely accepted product standards, we run the risk of gimmicks and gadgets being sold to trusting customers. Organized standardization, as represented by NEMA's standards on electric house heating equipment and UL label, represents the basis for honest product evaluation.

M. M. Brandon, Underwriters' Laboratories, Inc. — Fixed electrical space heating requirements were first introduced in the 1953 edition of the National Electrical Code after extensive study by a technical sub-committee. Temperature limitations imposed by the code are based upon the protection of combustible materials. Although the code is primarily an installation code, low-temperature space heating is treated with considerably greater detail than usual because of the manner in which the electric cable becomes a complete heating product through installation. Questions arising may be resolved by formal interpretations as provided for in the code, or informally by panel chairmen or committee personnel. The final decision is up to the inspection authority having jurisdiction.

Frank Stetka, National Fire Protection Assn.—One of the most important responsibilities of the electrical inspector is to make sure that at least minimum requirements are adhered to and that reasonable safety is assured without undue expense. Any feeling on the part of the installer that code provisions are too restrictive should be resolved through proper use of existing rules of procedure for revising the code.

F. H. Sides, National Mineral Wool Assn.—The mineral wool industry has formulated a new recommended industry standard for making the insulating value of any mineral wool product easy to determine and specify. Insulating products will be designated by "R" values, R being the reciprocal of the commonly used "U-factor." It will indicate the total insulating value of the product in place in the structure, taking into consideration the performance of the insulation itself, the value of adjacent air spaces, and the direction of heat flow. It will thus be unnecessary to calculate the number of inches of insulation required to meet any overall U-factor.

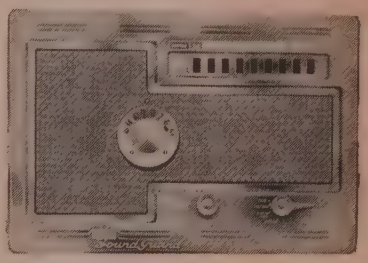
Paul W. Emler, American Electric Power Service Corp.—The disadvantage of the 6-4-2 insulating formula has been that different insulating materials have different thermal characteristics, producing variable results in overall insulating effect. The new All-Weather Comfort Standard for electrically heated and air-conditioned homes has been devised basing the Btu heat loss on the total sq ft area of the house, presenting different figures for different weather zones in the country and for different structural parts of the house. If the thermal performance values recommended for the individual parts are actually attained, the total recommended heat loss should be achieved.

Frederick J. Reed, Air Conditioning and Refrigeration Institute—For the present, heat pump standards should be confined to definitions, terminology, and safety requirements, since operating and construction possibilities are only just unfolding. Present ARI standards for unitary heat pumps are restricted to such requirements.

products of progress

ACCESSORY WITH PHOTOELECTRIC CONTROL ACTIVATES POST LANTERN

The Progress Nite-Guard will fit any 3" post. A photoelectric cell automatically turns the post lantern on at dusk and off at dawn. An exclusive control allows adjustment of on-off light levels. Simple to install, Nite-Guard offers homeowners protection and safety.



NEW ECONOMY MODEL INTERCOM FOR BUDGET PRICED HOMES

The "Cadet," an AM standard system, is a new addition to the Progress line of *Sound-Guard* Intercoms. Now builders of economy homes can offer the luxury of a radio-intercom. Since the housing kit is the same for all 4 *Sound-Guard* systems, the buyer has the choice of deluxe models — such as AM-FM, clock-controlled AM, or AM deluxe radio intercoms.

A NEW LINE OF ORIENT-INSPIRED LIGHTING

Illustrated is the No. 1300 — one of the new Meridian Collection by Dayna Lighting, Inc., a Progress subsidiary. The Dayna Meridian Collection offers graceful, dramatic new forms that reflect the exotic influence of the Far East.

PROGRESS MANUFACTURING CO., INC.
Dept. ECM-4, Philadelphia 34, Pa.
Please send me complete information on
☐ Nite-Guard ☐ Sound-Guard ☐ Dayna Meridian

Name_____

Company_____

Address_____

WHY LOOK FOR GROUNDS?

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ADALET INSULATING BUSHINGS

STRONG! PRECISION MOLDED! LOW PRICED!

- Adalet Molded Bushings are made with polyester fiberglass. They are thermosetting — not affected by wide temperature variations.
- Eliminates grounds and shorts, insure against expensive power interruption.
- Specify and insist on Adalet bushings from your wholesaler or write us today for samples and prices.

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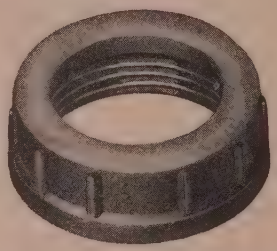

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TEMP-R-TAPE® GV

CHR'S pressure-sensitive, thermal curing Fiberglas tape meets MIL-1-19166 and Class H requirements . . .

Temp-R-Tape GV is made of .004" Fiberglas backing with a silicone polymer adhesive. This easy to apply, thermal curing tape adheres well to most materials, including Teflon* at temperatures ranging from −100°F. to 500°F. It possesses high dielectric strength, excellent moisture resistance and non-corrosiveness properties. Economically priced, Temp-R-Tape GV is specifically recommended for construction and repair of electrical and electronic equipment operating at high temperatures.

AVAILABLE FROM STOCK: ½" to 2" widths, 36 yd. rolls. Special roll widths to order. Color, natural. Sold nationally through distributors.

FREE SAMPLE and folder — write, phone or use inquiry service.

ELECTRICAL AND INDUSTRIAL SPECIALTY TAPES

CHR CONNECTICUT HARD RUBBER CO.

*duPont TM

Main office: New Haven 9, Connecticut

Following examples of case studies by France Anderson, Northern States Power Co., and Rev. Dean Burton of Lebanon, Ind., closing remarks by Exposition General Chairman Stanley Aronson, Berko Electric Mfg. Co., included an estimate of future electric heating sales of 210, 300, 400, 550, and 750 million dollars during the years 1961 through 1965, respectively. The figures exclude heat pumps and insulation, representing only retail equipment costs and labor for its installation.

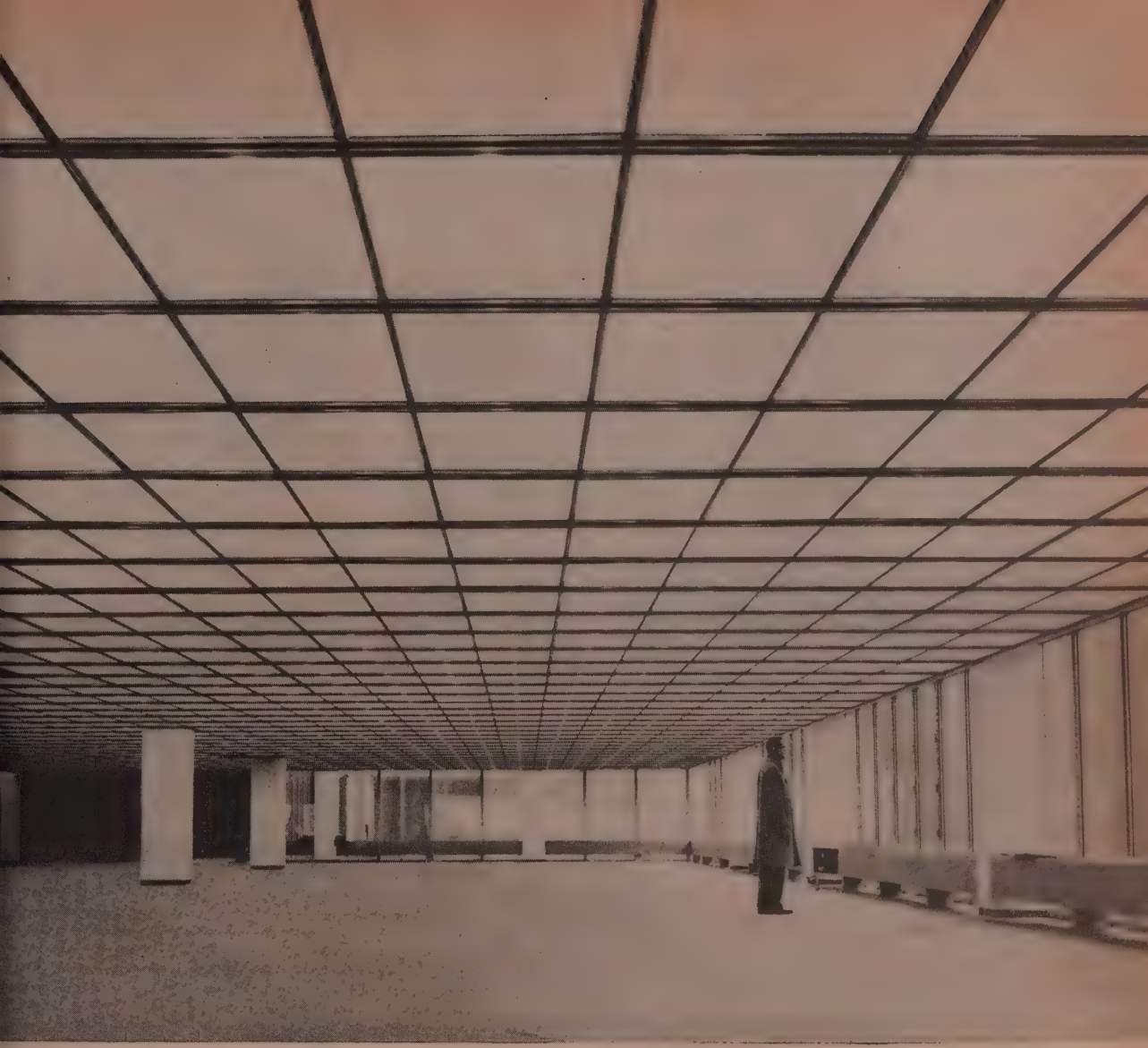
Electrical Industries New York Show Big Success

The 5th National Electric Industries Show, held in New York City's Coliseum March 6-9, was judged the most successful ever held in this city. Exhibitors and visitors were both reported as highly pleased with the show in every respect. Sponsored by the Eastern Electrical Wholesalers Association (EEWA), the show embraced over 300 exhibits by 180 manufacturers from all across the country. A record attendance of 22,127 people affiliated with the electrical industry viewed the exhibits.

The four-day show opened on Sunday, March 6. Hon. Armand D'Angelo, Commissioner of Water Supply, Gas & Electricity, City of New York, representing Mayor Robert F. Wagner, gave the welcoming address to the members of the electrical industry, and officially opened the show. Participating in the ribbon cutting ceremonies with Commissioner D'Angelo, as guest of honor, was Harry W. Bruggeman, electrical foreman in the Department of Buildings and Grounds at Columbia University. Mr. Bruggeman was presented with a scroll by the 5th National Electrical Industries Show management, honoring his 50 years of service to the public in the field of electricity.

Great interest was centered around the theme of this year's show, which was "From 1880 to 1960: An 80-year span from the first installation of electric current by Thomas Alva Edison to today's electricity by atom reactor." This theme was graphically represented by a portrait of Mr. Edison, and a three-dimensional animated model of Consolidated Edison Company's $100 million Indian Point nuclear generating station.

Strong international interest was displayed, as evidenced by re-



Here's the latest idea in continuous lighted ceilings...

It's in the new Union Carbide building on New York's Park Avenue. The light-diffusing panels of BAKELITE Brand rigid vinyl sheets are supported by stainless steel runners that are part of the ventilating and cooling systems and also serve to anchor the movable wall partitions.

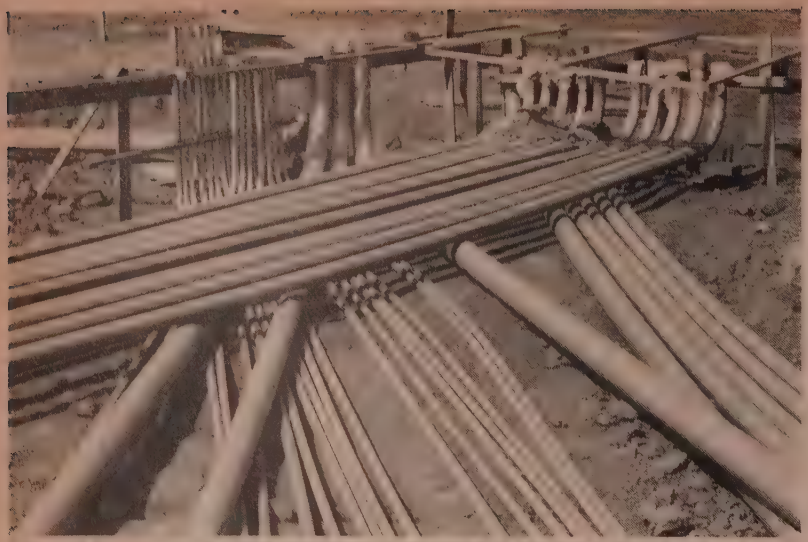
Today, you can get BAKELITE rigid vinyl sheets that are practically immune to the cracking that raises the cost of installing and maintaining continuous lighted ceilings. That's because these sheets are formulated and fabricated especially for light diffusion. They are expected to last for years without yellowing in standard installations.

They're self-extinguishing, but the installation can be designed so they'll soften and fall out before the sprinkler operating temperature. Installing them with baffles or laminating with special sound-deadening material gives them good acoustical properties. Costs can be cut because much thinner sheets can be used than for other types of diffusers.

There are many other things to look for in BAKELITE rigid sheets for continuous lighted and luminous ceilings. If you're not getting them all, write for facts, literature and a list of suppliers, Dept. DM-81K, Union Carbide Plastics Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Union Carbide Canada Ltd., Toronto, Ont.

UNION CARBIDE

"Bakelite" is a registered trade-mark of Union Carbide Corporation.



KRALOY PVC CONDUIT before encasement in concrete slab for large plant in Santa Ana, Calif.

CONTRACTORS REPORT INSTALLATION COSTS CUT 20% USING KRALOY PVC RIGID CONDUIT ... 1st PVC Conduit with U/L Listing*

Because of its extreme light weight and ease of handling, cutting and joining, the use of KRALOY PVC CONDUIT allows appreciable savings over use of other types of conduit. Only ⅛ the weight of steel, ½ that of aluminum, KRALOY'S many advantages make it the *ideal* conduit. KRALOY'S mirror-smooth interior walls make fishing easier, and it can be cut and joined with simple tools and solvent cement. For your customer's complete satisfaction, remember that KRALOY is rust-proof, pit-proof, non-magnetic, non-sparking, and won't support combustion. Consider the dollars to be saved using U/L listed* KRALOY—its trouble-free characteristics—and you'll insist on KRALOY PVC CONDUIT for your next job. Send the coupon today for the full story on KRALOY—the *only* PVC conduit with U/L listing*!

NOTE THESE WEIGHT COMPARISONS (LBS.)

Trade Size	½"	1"	2"	3"	4"	5"	6"
KRALOY PVC	**15.0**	**29.0**	**63.0**	**131.0**	**187.0**	**253.0**	**326.0**
ALUMINUM	27.4	53.0	115.7	238.9	340.0	465.4	612.9
STEEL	79.0	153.0	334.0	690.0	982.0	1334.0	1771.0

AC CONDUIT FITTINGS **KRALOY**

KRALOY PVC CONDUIT is sold only through wholesale electrical supply houses.

Kraloy Plastic Pipe Co., Inc., Dept. ECM-4
402 West Central Avenue, Santa Ana, Calif.

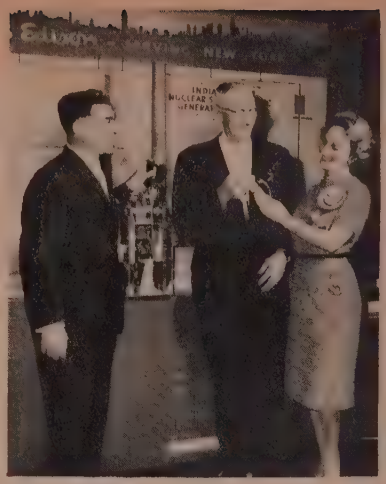
Gentlemen: Please send me your new Brochure on KRALOY PVC CONDUIT which gives complete information and installation directions.

Name _____

Address _____

City _____ Zone ____ State _____

*For direct underground burial or encased in concrete.



PARTICIPANTS in opening ceremonies for the 5th National Electrical Industries Show, held in New York City's Coliseum March 6-19, were (L to F): Armand D'Angelo, Commissioner of Water, Gas & Electricity for the City of New York, shown pushing the switch to turn on the lights for the show; Harry W. Bruggeman, electrical foreman for Columbia University; and Flora Drake, official hostess. Mr. Bruggeman was presented a scroll by the Electrical Industries in honor of his fifty years of electrical service at Columbia. In background is model of Con Edison's $100 million Indian Point nuclear electric generating station.

peated visits to the show by the British Consulate who expressed interest in not only promoting participation of British manufacturers in future shows but also in presenting such a show in the British Isles. Representatives of the Russian Embassy also made special visits to the show. And the Voice of America was so impressed by the exhibits that they had their Italian, Yugoslavian and French Divisions on hand daily to broadcast details of the show.

The show's exhibitors were well pleased with this four-day program, and reportedly closed orders for about 40% more goods than in previous shows. Attendance was by invitation only, and visitors were on hand from every state in the union.

NDECA Establishes Scholarship Grant

To encourage young men to enter the electrical contracting field, the North Dakota Electrical Contractors Association has established a scholarship in the electrical trades department of the North Dakota State School of Science at Wahpeton, N. D. The grant was set up as a memorial to Clyde Kieley, Graf-

ton electrical contractor and long-time member of NDECA.

Administration of the scholarship, which provides $150 annually to be applied to tuition costs, is in the hands of the Science School scholarship committee. The award is available to North Dakota residents only and preference will be given to students who indicate a definite desire to enter the electrical contracting field. NDECA hopes the recipient will become a licensed master electrician after meeting the requirements set forth by the North Dakota State Board of Electricity.

As of now, all who satisfactorily complete the 18-month electrical trades course at the Science School are allowed 18 months credit toward the "work time" needed to secure a license within the State of North Dakota. To meet eligibility requirements, license applicants, after completing school, must be employed by a master electrician in the state who will certify as to the applicant's work time and ability.

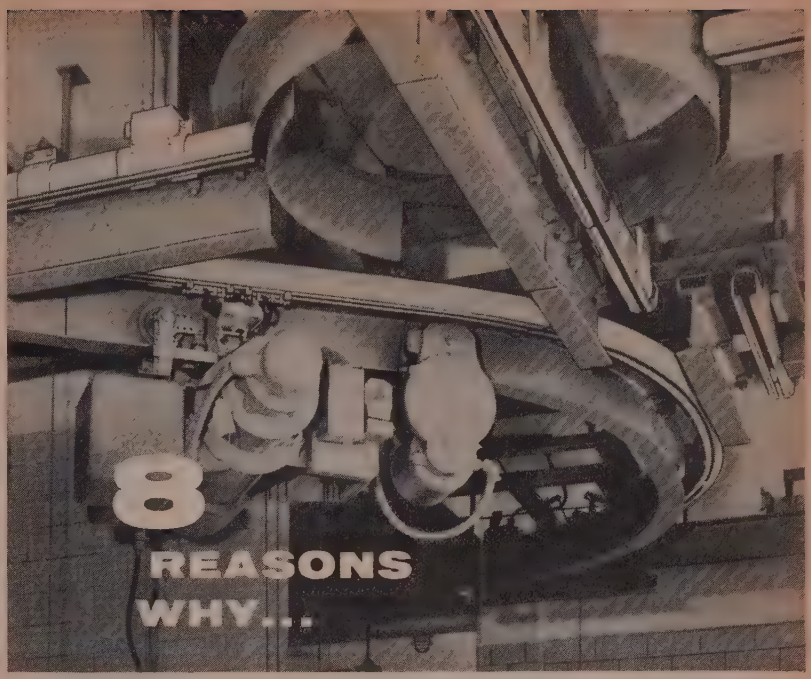
Stuart to Govern NECA's Montana Chapter

At the annual spring meeting of NECA's Montana Chapter, A. L. Stuart of the Bozeman Electric Co., Bozeman, Mont., was elected as Governor of that contractor group for the coming year. At the same meeting, C. O. Schmidt, Yellowstone Electric Co., Billings, was selected as incoming president; with Charles Powell, Hollingsworth Electric Co., of Kalispell, as vice president; Earl D. Coyne, Butte, reelected as secretary-manager, and R. W. Sundberg, Sundberg Electric Co., also of Butte, as treasurer.

Four Million All-Electric Homes By 1970

The completely electric home will emerge as an outstanding new pattern for living in the 60s, according to George T. Bogard, manager of General Electric's newly-formed Residential Market Development Operation. Speaking to the press at a National Electrical Week meeting, Mr. Bogard predicted American families in practically every income level will enjoy 4,000,000 all-electric homes and apartments by 1970 in which electricity will be the only heat and power source.

Emphasizing that this trend toward total electric Medallion



...discriminating buyers choose

FEEDRAIL

Crane & Hoist Electrification Systems

1. **Electrical Safety**—Heavy gauge steel housing encloses copper bus bars, track-supported trolleys with positive polarization and uniform contact pressure, and every other provision making an electrical system safe and fool-proof is incorporated.

2. **Personnel Safety**—Metal enclosure protects plant and maintenance personnel. No dangerous bar conductors and accident-causing broken wires, trailing or strung cables.

3. **Dependability** — Rugged, precise construction, pays dividends in power continuity and maintenance—keeps cranes and hoists rolling!

4. **Adaptability**—Prefabricated runs may be of any length, straight or curved, with turntables, slide or tongue switches. Readily adaptable to suit changed conditions, every part re-usable.

5. **Compactness**—Single metal housing occupies less than half the space of open conductors or sheathed bars. Looks neat, too!

6. **Easy Maintenance**—Replacement of parts is negligible. Any part can be replaced without interfering with the rest of the installation.

7. **Life-Time Use**—Never becomes obsolete! Assures power for the life of the crane or hoist. Outlasts other types of electrification.

8. **Low Installation Cost**—Nothing left to do on the job site but to connect units together—fast—because everything has been engineered to fit installation requirements. No special tools!

Information for you: Bulletins are available on Feedrail 60 Ampere Systems (90 Ampere Intermittent Service); 100 Ampere Systems (150 Ampere Intermittent Service); and Heavy Duty Systems of 225, 375 and 500 Amperes. See your local Electrical Distributor or write Feedrail, Department C-4.

Never Becomes Obsolete

ELECTRIC FEEDRAIL®

FEEDRAIL CORPORATION

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125 BARCLAY STREET • NEW YORK 7, N.Y.

SPECIALLY QUALIFIED REPRESENTATIVES IN PRINCIPAL CITIES

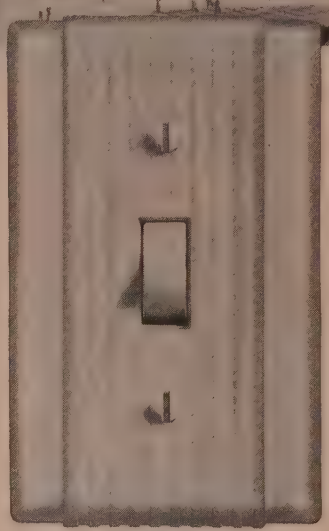
P&S ROCKER-GLO

Quality you can measure by Performance

Sparkling new Libbey-Owens-Ford Building in Toledo, Ohio, rises 15 floors above street level. New, modern, 20-ampere, Rocker-Glo switches control the lights used in all office areas.

P&S Rocker-Glo can be used on fluorescent and tungsten filament loads at full current rating. Quiet in operation, it is smoothly activated by pressing, pushing, rocking or rolling.

Note: P&S Super AC Switches (20AC1) were also used in this building in all hallways and laboratories.



Rocker-Glo, 2251

For information, write Dept. ECM-46A

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P&S PASS & SEYMOUR, INC.
SYRACUSE 9, NEW YORK

60 E. 42nd St., New York 17, N.Y. 1440 N. Pulaski Rd., Chicago 51, Ill. In Canada: Renfrew Electric Co., Ltd., Toronto, Ontario

Homes is well underway, Mr. Bogard cited the more than 600,000 families who are already experiencing safe, clean electric heat.

Nationally, the program will stress the benefits of Medallion home living through national advertising and information services. Among the latter is a new color and sound film for home owners and home buyers, a consumer home planning booklet now being prepared, and the Electric Heating Institute which contains educational slide films and manuals for the consumer, utilities and electrical trades.

Through this extensive program, General Electric's Residential Market Development Operation hopes to insure the construction of the 137,000 Medallion Homes predicted for the industry during 1960. Initially, activity will be concentrated in large metropolitan areas.

The Medallion Home is part of the industry-wide Live Better Electrically program which calls for new standards of excellence in electrical heating, appliances, lighting and wiring. Qualifying homes are awarded the Medallion by their local electric light and power company.

Gold Medallion homes will feature electric heating, cooling, light for living, full housepower, at least four major appliances in the kitchen plus optional electric housewares, and electronic home entertainment.

CLI Cites Chicago Merchant

National Electrical Week and Thomas A. Edison's birthday will have added meaning for J. Chalmers O'Brien, vice president and public relations director of Carson Pirie Scott & Company, Chicago, and president of the State Street Lighting Association—a merchant organization that owns and operates the lighting system for one of America's busiest mercantile thoroughfares.

On February 11, Mr. O'Brien was awarded the coveted Chicago Lighting Institute Citation "for meritorious achievement in the advancement of the science and art of illumination or the application of good lighting engineering principles in the area served by the Chicago Lighting Institute." He was honored for his untiring efforts in transforming the 7-block State Street area into the world's bright-

FOR POSTERITY. Chicago Lighting Institute Citation award winner J. Chalmers O'Brien (right), president State Street Lighting Association and vice president, Carson Pirie Scott & Co., watches his nameplate being mounted to permanent Citation Plaque in Institute headquarters by Citation Chairman, A. E. Swedenborg, vice president, Benjamin Division, Thomas Industries, Inc.

est shopping district through the now historic radio-controlled State Street Relighting Project.

Following receipt of a mounted Citation Scroll from CLI President O. A. Hill, Mr. O'Brien witnessed the attachment of his nameplate to the permanent Citation Plaque in the Institute headquarters. Citation chairman A. E. Swedenborg, vice president, Benjamin Division, Thomas Industries, Inc., mounted the plate. The ceremonies took place during the annual meeting of the CLI membership.

After the ceremony, members heard Berlon Cooper, associate editor, *Electrical Construction and Maintenance*, predict a bright future for the lighting industry. Sales of lighting equipment alone should increase from an anticipated $605 million this year to an estimated $1.4 billion by 1970. Higher lighting levels, improved light sources, new light control materials, modern architectural and structural design trends and the vast relighting market will all contribute to the predicted upswing, he noted.

NISA News

The Connecticut Chapter joined with New England Chapter to sponsor the Northeast Region Annual Foremen's Meeting, March 19, at Hotel Sheraton-Kimball, Springfield, Mass.

• • • •

More than 100 attended the February 16 meeting of Great Lakes Chapter at McNaughton-McKay Electric Co., Detroit, enjoying a buffet dinner and a travel movie. The group will meet at Standard

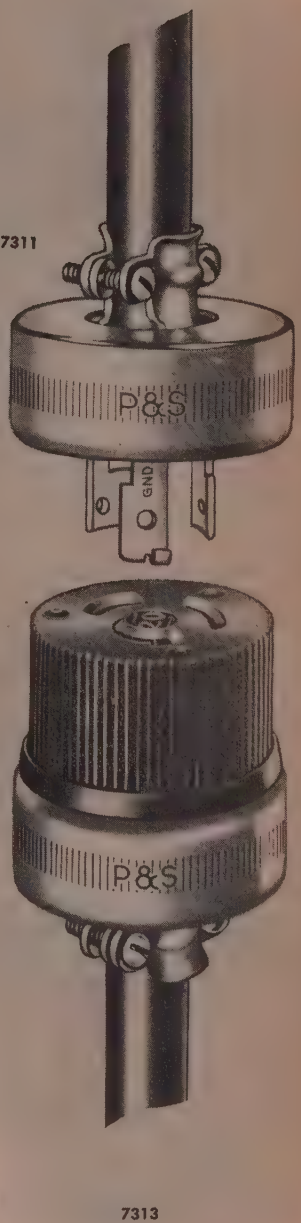
P&S TURNLOK

Built to Take It

P&S TURNLOK wiring devices are designed to give trouble-free service no matter how tough the going gets. TURNLOK devices are available in 10 and 20 Amperes, 2-, 3-, and 4-wire types: receptacles, connectors and caps.

All P&S TURNLOK devices have extra large head binding screws and ample wireways for quick, easy wiring. Armored sections are anchored securely. Cap blades are positioned accurately. Contacts are anchored securely. Fastening screws in connectors are secured in body . . . cannot fall out in wiring. Ratings are plainly visible.

For information about P&S TURNLOK Line, write Dept. ECM-46B.



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A sprinkler system is only half protection

YOU NEED Autocall® AUTOMATIC WATERFLOW ALARM DEVICES!

When a sprinkler head goes into action, it can extinguish a fire or keep it from spreading rapidly... but without reliable alarm devices, thousands of gallons of water may flow before the open head is discovered.

Autocall Waterflow Indicators, incorporated in your sprinkler system, will protect your property from excessive water damage by insuring prompt and automatic alarm signaling. They may be added to existing fire alarm equipment or Autocall can provide a complete fire alarm system.

Installation is simple, the cost is reasonable and the protection is complete. Write or phone for full information.

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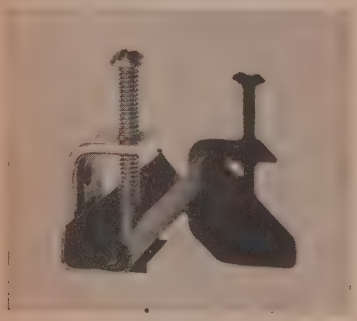
FIRE PROTECTION SYSTEMS

THE AUTOCALL COMPANY • SHELBY, OHIO • SALES OFFICES IN PRINCIPAL CITIES

Fastens In Any Position—Easily, Quickly, Securely!



PAINE'S Versatile, New Junior Beam Clamp

Solves the problem of securing conduits, switchboxes, pipe, etc. onto "I" beams, ceiling channels, web joists or any type of building framework requiring lightweight, flush-mounted fastening. Try some! Write today, or contact your nearest PAINE representative.

- Designed for use with 1" wide and up channels, ¼" and "U" shaped or "I" beam members.
- Can be adapted for a variety of applications, including the horizontal or vertical holding of electrical boxes needed to feed recessed fixtures.
- Also effective for hanging a continual row of lighting fixtures in many styles.
- Assures a hidden method of holding conduit pipe, cable above false ceilings.
- Mounts flush against channel, makes conduit runs neater, more even, stronger.
- Works ideally with any Paine conduit clamp.

the best craftsmen always take PAINE'S

THE PAINE COMPANY, 20 Westgate Road, Addison, Illinois

Electric Motor Works, Detroit, April 18, to inspect the firm's new equipment and building.

• • • •

NISA's international president Horace C. Blenkhorn was the principal speaker at a meeting of the Indiana Chapter on April 1. Mr. Blenkhorn discussed association programs and policies and described the objectives of the organization.

• • • •

Bruce Shaffer, service engineer, Allis Chalmers Manufacturing Co., was the principal speaker at the Midwestern Chapter's spring meeting at Sheraton-Martin Hotel, Sioux City, Iowa, March 26. Marvin J. Klass, lawyer, discussed incorporation problems and advantages; C. B. Lehman, warehouse manager, Delco Products Co., talked on credit and collection methods and systems.

• • • •

A 10,000-sq-ft addition, its sixth in eight years, has been built by Hannon Electric Co., Canton, Ohio.

• • • •

A famous sports arena widely known to TV boxing fans, the New Orleans Coliseum Arena, has been bought for more than $100,000 by Industrial Electric, Inc. to meet expansion requirements.

• • • •

A tour of Pacific Gas & Electric Co.'s steam generating plant at Hunter's Point preceded a meeting of Northern California Chapter at Schroeder's restaurant at which NISA vice-president-elect George Larsen, of Larsen-Hogue Co., Los Angeles, was the principal speaker.

• • • •

Carl Strock, Center Electric Engineering Co., Tacoma, Wash., was elected president of the Puget Sound Chapter at a meeting March 1 at Andy's Diner, Seattle, Wash. Hal Tingstrom, Tingstrom Electric Co., Centralia, Wash., was chosen vice-president; and Allen Patchett, Industrial Electric Co., Everett, Wash., secretary-treasurer.

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Arthur Roe, NISA engineer, Ed Jenkins and Roy Shinault, members, were the principal speakers at the Southeastern Chapter's 6th Annual Technical Forum of Electrical Equipment, Hotel Charlotte, Charlotte, N. C., April 1 and 2.

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R. M. Vara, service engineer, Reliance Electric & Engineering Co., Cleveland, Ohio, discussed "Administrative Coordination between Service Shops and Motor Manufacturing" at the spring meeting of Southwestern Chapter, March 10-12 at Hotel Baker, Dallas, Texas.

Other speakers were: E. Diebold, International Rectifier Corp., El Segundo, Calif., "New Form of Rectification of A-C Current"; L. Kowal, service specialist, Metals & Controls Corp., Attleboro, Mass., "Inherent Motor Protection and Its Relationship to the Motor Repair Shop"; Ken Elliott Jr., Manager, Ken Elliott Motors, Inc., Bossier City, La., "The H-A-S Phase Conversion System and How It Operates"; Bill D. Chumley, general manager, American Kloeckner-Moeller Corp., "A New Philosophy in Motor Controls"; Arthur C. Roe, NISA engineer, "NISA Regional Practical-Technical Seminars"; Harry L. Saums, research director, "Epoxy Magnet Wire Development and Use"; N. F. Faas, Perfecto-Peen Division, Aero-Test Equipment Co., Inc., Dallas, Texas, "The Revolutionary Perfecto-Peen Method for Cleaning and Conditioning Metals."

• • • •

Walter Meyer and Wally Mercer, Furnas Electric Co., were the speakers at a meeting of the Wisconsin Chapter at Germantown, Wis., February 16.

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Motor protectors were discussed at the New York Chapter's February 18 meeting at Hotel Shelburne.

• • • •

A large delegation from the New England Chapter turned out in Boston on January 26 to help the Master Electricians Association honor Gerald J. Connor, of Stearns, Perry & Smith Co., for his contribution to the electrical industry during the last half-century.

• • • •

The annual foremen's meeting, sponsored by New England and Connecticut Chapters, was held March 19 at Hotel Sheraton-Kimbal, Springfield, Mass. Speakers included: Carroll Mortimer, service engineer, Controller Service & Sales Co., Boston, Mass., "How To Keep Things under Control"; W. Maijala and A. Kocsis, service engineers, Reliance Electric & Engineering Co., Cleveland, "Servicing Reliance V-S Drives"; Warren Stuart, sales development manager, Belden Manufacturing Co., Chicago, "Selling Techniques." Ed Slowick was chairman of tours which included visits to Associated Electric Motor Repair and Superior Electric of Springfield. Session chairmen were Robert G. Bedig, Al Lebowitz, William Palmer, Charles Zalewski and Robert L. Sandman. NISA president Horace C. Blenkhorn also spoke.

GO AHEAD...

explain nuisance tripping to him

Heat's on, conditioner's out. How come?

Some annoying power interruptions are due to inadequate wiring. A vast number are due to nuisance tripping of circuit breakers or nuisance fuse blowouts.

Fuses and many circuit breakers operate on the basis of heat. They are sensitive to heat from within the circuit and without. Thus, on hot days thermal protectors are often near the tripping point even though the circuit is not fully loaded. As heat builds up, nuisance tripping results.

Heinemann hydraulic-magnetic circuit breakers *ignore heat*—respond only to *current* (amperage) which is the true determinant of electrical load. These circuit breakers will carry the full, safe capacity on the hottest days. Nuisance tripping just doesn't occur.

In Heinemann circuit breakers, actuation is entirely magnetic; inverse time delay is provided by hydraulic means. When protection is needed, interruption is fast. When the circuit is safe, power stays ON.

***For consulting engineers,* the full story is given in an informative booklet, Manual 101: "What You Should Know About Circuit Breakers." Write for your copy.**

HEINEMANN

HEINEMANN ELECTRIC COMPANY
132 Plum Street, Trenton 2, N. J.

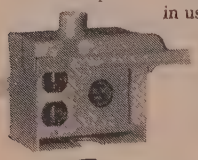
Circuit breakers

All-Purpose,
Weatherproof

POWER OUTLETS

- For Mobile Home Parks
- Farm and Ranch use
- Outdoor Construction

MODEL "50-15" solves power problems for Mobile Home Parks because it receives a wide variety of plugs. Offers a 50 amp. 250 volt 3-wire power receptacle, and a 15 amp. grounded duplex receptacle. Protected with two 50 amp. circuit breakers and fuse. Ample space for plug-in adapters when needed. Top hub and bottom knockouts facilitate overhead or underground connections. Completely weatherproof. Cover closes and can be padlocked when in use. Cords hang through rounded cord slots.



MODEL 34 offers 15 amp., 125 volt grounded duplex receptacle with 15 amp. fuse protection. Sixteen other "Hoffman" power outlets are available with choice of 15, 20, 30, 35 and 50 Ampere receptacles to fit your exact needs. Write us.

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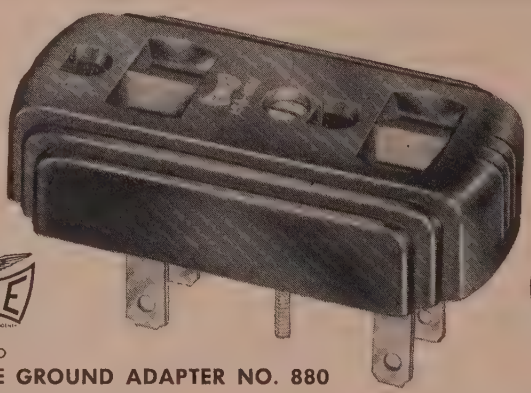

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CUTS MAINTENANCE COSTS

SAVES TIME AND MONEY

Now—with the patented Eagle No. 880—standard receptacles can be converted to take 3 wire U Ground plugs, easily, quickly. The installation of grounding protection is now easy, anywhere. The patented Eagle No. 880 may be installed for permanent or temporary use without disturbing present receptacles. No wiring is required. Rated: 15 amperes, 125 volts. Listed by Underwriters' Laboratories Inc. Available in Brown or Ivory.

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ACCEPT NO SUBSTITUTES — SOLD THRU WHOLESALERS
SEND FOR FREE POCKET CATALOG

EAGLE ELECTRIC MFG. CO., INC.
LONG ISLAND CITY 1, NEW YORK
"PERFECTION IS NOT AN ACCIDENT"

DATES AHEAD

International Association of Electrical Inspectors—Chapter Meeting—**Ellis Cannady,** Carolina Hotel, Raleigh, N. C., April 12-13; **Alabama,** Admiral Semmes Hotel, Mobile, Ala., April 25-26; **Tennessee,** Andrew Jackson Hotel, Nashville, Tenn., May 2-3; **Florida,** George Washington Hotel, West Palm Beach, Fla., May 5-7; Joint five chapter meeting **North Louisiana-East Texas, Baton Rouge, George Welman, Texas Gulf Coast,** Hotel Marshall, Marshall, Texas, May 6-7; **Georgia-South Carolina** joint meeting, DeSoto Hotel, Savannah, Ga., May 9-10; **Wisconsin,** Schroeder Hotel, Milwaukee, Wis., May 12-13.

NISA Chapter Meetings — New England, Boston, Mass., April 14; **Great Lakes,** Detroit, Mich., April 18; **North Central,** Minneapolis, Minn., April 22; **King Coal,** Kentucky Lake, Ky., April 27; **Southwestern,** Austin, Texas, September 22-24.

Illuminating Engineering Society—Regional Conferences: **South Central and Southeastern,** Peabody Hotel, Memphis, Tenn., April 22-23; **Southwestern,** Robert Driscoll Hotel, Corpus Christi, Texas, April 25-26; **Inter-Mountain,** Mountain Shadows Resort, Scottsdale, Ariz., April 28-29; **South Pacific Coast,** Ambassador Hotel, Los Angeles, Calif., May 4-6; **Pacific Northwest,** Benjamin Franklin Hotel, Seattle, Wash., May 9-10; **Midwestern,** Sheraton-Martin Hotel, Sioux City, Iowa, May 12-13; **Great Lakes,** Carter Hotel, Cleveland, Ohio, May 16-17; **Northeastern,** Wentworth-By-The-Sea, Portsmouth, N. H., June 8-9; **Canadian,** Nova Scotian Hotel, Halifax, N. S., June 13-14.

Maintenance and Plant Engineering Conference—Chase-Park Plaza, St. Louis, Mo., April 25-26.

LANDON HUDSON, partner, Buckner Electric Motor Service Company, Kokomo, Ind., devotes most of his time to record keeping, billing and other miscellaneous office procedures necessary to the successful operation of a motor repair shop.

Western Air Conditioning Show — Western Air Conditioning, Heating, Ventilating and Refrigeration Exhibit and Conference, Shrine Exposition Hall, Los Angeles, Calif., April 27-30.

National Association of Electrical Distributors—Annual convention, Dallas, Texas, May 1-5.

National Industrial Service Assn., Inc.—Annual convention, Hotel Fontainebleau, Miami Beach, Fla., May 8-11.

National Fire Protection Assn.—Annual meeting, Montreal, Canada, May 16-20.

Pacific Coast Electrical Assn.—Annual convention, Stardust Hotel, Las Vegas, Nev., May 16-18.

Design Engineering Conference and Show—Statler-Hilton and Coliseum, New York, N. Y., May 23-26.

Construction Caribbean—A building materials show, San Juan, Puerto Rico, June 3-9.

Edison Electric Institute—Annual Convention, Atlantic City, N. J., June 6-8.

New York State Association of Electrical Contractors & Dealers—61st annual convention, Whiteface Inn, Lake Placid, N. Y., July 3-8.

National Association of Lighting Maintenance Contractors—National conference, Milwaukee Inn, Milwaukee, Wis., August 22-24.

Illuminating Engineering Society—National Technical Conference, Penn-Sheraton Hotel, Pittsburgh, Pa., September 11-16.

International Association of Electrical Inspectors — Northwest Section, Sheraton-Portland Hotel, Portland, Ore., September 12-14, **Southwest Section,** Mapes Hotel, Reno, Nev., September 19-21; **Eastern Section,** September 26-28; **Western Section,** Continental Hotel, Kansas City, Mo., October 3-5; **Canadian Section,** Toronto, Ont., Canada, October 8-9; **Southern Section,** Rice Hotel, Houston, Texas, October 17-19.

Pennsylvania Electric Assn.—53rd annual meeting, Penn-Sheraton, Pittsburgh, Pa., September 20-22.

International Association of Electrical Leagues—25th annual conference, Hotel President, Kansas City, Mo., October 5-7.

National Electronics Conference—Hotel Sherman, Chicago, Ill., October 10-12.

Florida Association of Electrical Contractors—Annual Convention and 8th Electrical Trade Show, Deauville Hotel, Miami Beach, Fla., October 12-15.

National Electrical Contractors Association—1960 anuual convention, Las Vegas Convention Center, Las Vegas, Nev., October 23-27.

National Electrical Manufacturers Assn.—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 14-18.

Electrical & Home Appliance Show—Electrical Building, Balboa Park, San Diego, Calif., November 25-30.

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FIRST CHOICE

among men who know portable cord!

Yes, more electrical contractors and maintenance men specify Royal than any other portable cord in its class! Why? The reason is simple, but important to men with jobs that depend on the quality, safety and durability of the flexible cord they use: every foot of ROYAL cord and cable meets the high-performance standards you need on the job.

Your wholesaler stocks a complete range of Royal types and sizes — rubber, neoprene and plastic jacketed cords, power cables, thermostat cable, lamp and fixture wires, machine tool wires, and heavy-duty "POWR-KORD" extensions. All *made* right, *priced* right, *packaged* right — quick and easy to use!

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MISTER ELECTRICAL CONTRACTOR!

● **YOU SHOULD BE IN FASTEST GROWING MULTIPLE MILLION DOLLAR PART OF YOUR CONTRACTING BUSINESS.**

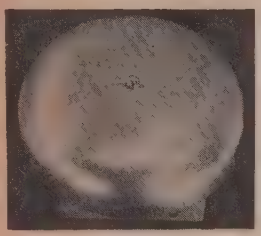
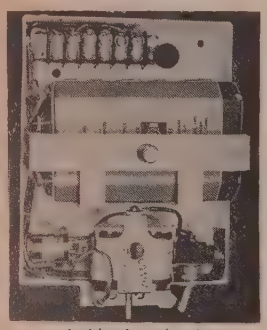


Photo showing 8 in. bell of LIFE SAVER SR. MODEL C1



Inside view showing mechanism of MODEL C1

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Look for it at your electrical distributors . . . and order the fittings that save you time, build a reputation for quality service.

Blackhawk Industries DUBUQUE, IOWA

where the new ideas come from

NAVY FIELD HOUSE LIGHTING [FROM PAGE 107]

the level of the catwalk floors. These units are spaced 8 ft on centers. The center axis of each "A"-unit floodlight is aimed at a point on the floor 44 ft from a vertical line through the facing side of the catwalk, or just 8 ft short of the center line of the floor area. This puts the center of the floodlight beam at an angle of 37.5 degrees with the vertical.

Additional floodlights of the same type were also installed along the catwalk railings adjacent to the area where the portable basketball court is installed. In this area, a floodlight is installed every 4 ft along the railing. These additional units, designated as "B" units, are aimed at a point 20 ft out from the intersection of a vertical line through the units and the floor, or at an angle of 20° from vertical.

All of the floodlights designated as "C" units are aimed at a point 7 ft out from the intersection of the vertical line through the units and the floor, or at an angle of seven degrees from the vertical. The angle of mounting for the "C" units assures proper lighting at the sides of the football field, which extend back under the catwalk. Aiming points and mounting angles are shown schematically in the elevation designated as "Section X-X."

When the Field House is used for football, the illumination is provided by "A" and "C" unit floodlights only. For basketball, the lighting is provided by the "A" and "C" units at either end of the basketball court only, plus the "B" units located at this point.

The catwalks serve three functions. They provide 1) easy access to floodlights, 2) a location for mounting the units, and 3) support for wireways which house branch circuits.

Planning, design and construction of the Field House for the U. S. Naval Academy were under the general direction of Vice Admiral James L. Holloway, USN. Architects were Harbeson, Hough, Livingston & Larson, Philadelphia, and Von Storch, Burkavage & Scandide, Waverly, Pa. Consulting engineer for the project was John P. O'Malley, Scranton, Pa., and electrical construction work was done by the Walter Truland Corporation, Arlington, Va.

Among the Manufacturers

Headquarters Announcements

All-Steel Equipment Inc., Aurora, Ill., has purchased assets and business of Conduit Fittings Div. of U. S. Industries, Inc., Chicago, Ill.

Arrow Conduit & Fittings Corp. has moved its factory and office to 108-20 180th St., Jamaica 33, N. Y.

Hevi-Duty Electric Co., Milwaukee 1, Wis.—Elton E. Staples, president.

McPhilben Lighting, Inc., Brooklyn, N. Y.—Edward L. Gluck, sales manager.

Crouse-Hinds Co., Syracuse, N. Y.—Austin D. Vanderbilt, manager, industrial engineering; Richard W. Scott, administrative engineer, Engineering Div.

Bishop Mfg. Corp., Cedar Grove, N. J.—Newton H. Tuthill, president; Frank X. McCormack, vice-president of sales.

National Electric Div., H. K. Porter, Inc., Pittsburgh, Pa.—Charles R. Billman, general manager; Ray Schuler, product manager, underfloor raceways; Irvin C. Turner, product manager, surface raceways.

I-T-E Circuit Breaker Co., Philadelphia, Pa.—Harry L. Buck, executive vice president; Nye S. Spencer, manager, utility marketing.

Sylvania Lighting Products, New York—Walter K. Anderson, manager of equipment development; Robert L. Kleinfeld, vice president-marketing, photolamp and special products; Frederick H. Heintz, vice president-marketing, large lamp products.

General Electric Co., Cleveland, Ohio—John S. Harrington, manager, decorative lamp sales; Albert F. Brun, manager, replacement lamp sales; Gomer F. Davis, marketing manager—all with Miniature Lamp Dept.; Kirk M. Reid, manager of lighting education, Large Lamp Dept.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Robert C. Bown, assistant manager, Rectifier Section; T. G. A. Sillers, manager of new Power Systems Engineering Dept., Power Equipment Div.; D. B. Scott, manager of Control Dept.

Westinghouse Electric Corp., Pittsburgh, Pa.—Robert L. Zahour, manager of lamp applications, Lamp Div.

CAN YOU COUNT THE CONVENIENCE OUTLETS IN THIS LABORATORY?

Dunham Laboratory, Yale University

ONE *Free* WIREMOLD SCREWDRIVER

to every contractor or engineer who sends in his guesstimate of the number of outlets in the absolutely unretouched photo at left. (Two screwdrivers for each **correct** answer! **Nobody** ever loses with Wiremold!) PLUS A CERTIFICATE THAT PROVES YOU ARE A GENUINE ELECTRICAL EAGLE-EYE!

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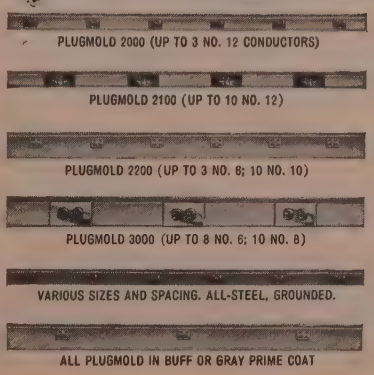
That's why contractors like PLUGMOLD. It's so easy to install; makes every job look so **good.** The customer is always right — always **satisfied**—with PLUGMOLD.



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NEW IDEA

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There's no other room thermostat like it. Its large dial actually "meters" desired temperature changes. Each "click" is a change of 1° . . . reduces tendency to over-, or under-adjust. And, it gives faster response to both convective and radiant heat. You'll also like the faster installation and easier wiring. Write for Bulletin 3205 . . . it's free!

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AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

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Single stroke or vibrating

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For all telephone or alarm systems. Housings of sturdy cast aluminum with excellent clarity and high decibel output. Underwriters Laboratories listed. Also a full line of cow bells and buzzers.

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RIGID *Conduit* PIPE COUPLINGS

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½" to 6" sizes
ALUMINUM
BLACK ENAMELED—
HOT DIP GALVANIZED

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CONDUIT NIPPLE MFG. CO.

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Garcy Lighting, Chicago, Ill.—John Metelnick, general manager.

Thomas Industries Inc., Louisville, Ky.—Lee B. Thomas, president.

Sorenson & Co., South Norwalk, Conn.—Jesse Stitzer, engineering manager.

H. K. Porter Co., Inc., Pittsburgh, Pa. — Fred W. Elliott, James A. Drain, Emmett H. Mann, and B. Campbell Blake, group vice presidents.

Kennecott Copper Corp., New York—Walter H. Page, director.

G & W Electric Specialty Co., Blue Island, Ill. — Norman O. Kirkby, general manager; Robert G. Poetsch, sales manager.

Auth Electric Co., Inc., Long Island City, N. Y. — John H. Deegan, general sales manager.

Boston Woven Hose & Rubber Div., American Biltrite Rubber Co., Boston, Mass.—Donald B. White, electrical tape product manager.

Motor Appliance Corp., St. Louis, Mo.—A. H. Barrere, Jr., general sales manager.

Edwards Co., Norwalk, Conn.—G. W. Rhein, product manager.

Diamond Expansion Bolt Co., Garwood, N. J.—William Maish, director of marketing.

Ackerman-Johnson Co., Chicago, Ill.—Vincent G. Probst, U. S. regional sales manager.

Marcus Transformer Co., Rahway, N. J.—Leon Newler, director.

General Electric Co., Schenectady, N. Y.—Harland P. Sisk, general manager, Distribution Transformer Dept., Pittsfield, Mass.

Plastic Wire & Cable Corp., Jewett City, Conn.—Herbert W. B. Farr, executive vice president; James T. Daly, vice president and sales manager; George H. Lane, treasurer; James E. Flood, vice president and technical director; Gordon H. Sigman, vice president and purchasing agent; J. Vincent McBride, vice president and development director.

Coleman Cable and Wire Co., River Grove, Ill.—Victor Surprenant, production manager.

Dayton Rubber Co., Dayton, Ohio—L. J. Keyes, vice president and director of purchases.

Wheelock Signals, Inc., Long Branch, N. J.—Theodore N. Saaty, director of engineering.

Regional Appointments

NEW ENGLAND

Dayton Industrial Products Co.: Frank W. Garner Co., Boston, representative in New England area.

Rockbestos Wire & Cable Co.: John H. Cosmar, sales manager.

Corning Glass Works: Donald F. Moulton, representative in New England for Lighting Sales Dept.

MIDDLE ATLANTIC

National Electric Div., H. K. Porter Co.: Patrick J. Cody, Pittsburgh branch manager.

I-T-E Circuit Breaker Co.: Karl Kelly, manager, Pittsburgh district sales office.

Berns Air King Corp.: Stan Sugarman, eastern sales manager.

Dayton Industrial Products Co.: A. Weingarten Corp., Philadelphia, representative in eastern Pennsylvania, New Jersey, and Wilmington, Delaware, area.

Stromberg Div., General Time Corp.: Robert C. Baird, time equipment branch manager, New York City office.

Westinghouse Electric Corp.: Edward A. Zagula, representative for electric heating products, Pittsburgh, Pa.

SOUTH ATLANTIC

Wiremold Co.: Thomas J. Pugh, manager of Philadelphia-Baltimore-Washington sales district.

I-T-E Circuit Breaker Co.: C. E. Wood, district manager, Miami sales office.

Dayton Industrial Products Co.: Bloom Associates, Baltimore, representatives for line of electrical tape in Maryland and Washington, D. C.

Westinghouse Electric Corp.: E. W. L. Seager and Foster Massey, representatives for electric heating products in Staunton, Va., and Atlanta, Ga., respectively.

EAST CENTRAL

Berns Air King Corp.: William J. Rosen, Midwestern sales manager, in addition to duties as general sales manager.

Dayton Industrial Products Co.: Curtis Sales Corp., Cleveland, representatives for line of electrical tape in central and northern Ohio.

Thor Power Tool Co.: Paul J. Kennedy, district manager, Cleveland sales and service branch.

Ackerman-Johnson Co.: George Spinka, Midwest sales manager.

Boston Woven Hose & Rubber Div., American Biltrite Rubber Co.: Edward A. Damrau, representative in West Virginia and western Pennsylvania;, R. A. Hanks, representative in parts of Indiana, Wisconsin, and Illinois.

Westinghouse Electric Corp.: H. J. Rudisaile and Arthur F. Holland, representatives for electric heating products in Chicago, Ill., and St. Louis, Mo., respectively.

Carlon plastic conduit entirely eliminates common conduit problems; corrosion, leaky joints and absorption through the conduit wall. It installs in a fraction of the time required for many materials. Material costs are low, too.

Now there's a plastic conduit available for many of your conduit applications.

ECONOLITE

Designed for either direct burial or concrete encasement. Available in 30 foot lengths.

PV-DUIT

Non-corrosive . . . perfect for corrosive applications, industrial and underground use.

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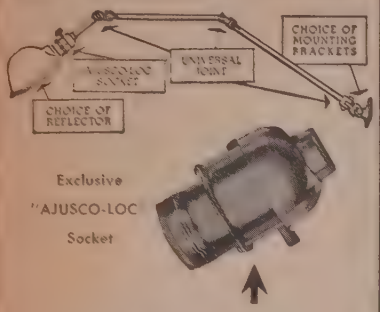
LOCAL LIGHTING
FOR MACHINE AND BENCH
Easy to Use—Hard to Damage



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Ajusco-Loc Socket - Guaranteed not to break, kink, twist or pull apart.

Put the light where you want it and it stays there—no sagging or slipping. Eliminate costly repairs and lost time with these fixtures that stay on the job and out of the repair shop.

Write today for Catalog 66
There's a "right" fixture for every job.

Adjustable
AJUSCO FIXTURE CO.
Established 1911
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POW-R-SPADE GUARANTEES PRODUCT & PERFORMANCE!

- Stampings has over five year's experience in building trouble-free, productive trenchers.
- Stampings has sold more trenchers in their class than all other manufacturers combined. There is a reason.
- Shipment made within 1 day after order, and completely assembled, ready to work.
- Pow-R-Spade digs straight, curves, angles without preliminary set-up. Trenches 3" wide to 24" deep—or 4" wide to 18" deep.
- Dealers in principal cities.

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STAMPINGS INC., Dept. E, Rock Island, Ill.

General Electric Co.: Harold E. Bentz, manager of Buckeye Sales District, Cleveland, for Large Lamp Dept.

Sylvania Lighting Products Inc.: L. John Doyle, Chicago, Midwest regional sales manager.

Hexcel Products Inc.: Donald J. Kennedy, regional sales manager, industrial products, in Chicago area.

Vickers Inc.: W. G. Kerr Co., Pittsburgh, representative for Electric Products Div. in parts of Maryland, West Virginia, and Ohio and all of Pennsylvania.

Nelson Electric Mfg. Co.: Jack L. Gates, sales and service representative in Louisiana and Mississippi.

WEST CENTRAL

Edwin F. Guth Co.: Roger E. Bessmer, representative in western Missouri and northern Kansas.

Wolverine Tube, Div. of Calumet & Hecla, Inc.: Gordon R. Jobe, representative in Dallas district.

Triangle Conduit & Cable Co.: John F. McKiernan, district manager of Houston territory.

Pfaff & Kendall: B. E. Watson & Associates, representatives in northern Texas and Oklahoma.

WEST

General Electric Co.: Leonard J. Sacks, western district sales manager for Silicone Products Dept.

Berns Air King Corp.: Al Grossman, western sales manager.

General Electric Co.: George S. Trotter, manager of western sales region for Large Lamp Dept.

OWEN GOLLAR JR, of William C. Krauth Electric Co., Louisville, Ky., president of the Louisville Chapter of NISA, greets NISA president Horace C. Blenkhorn (right), of Blenkhorn & Sawle, Ltd, St. Catharines, Ont., Canada, at a recent meeting of chapter officers. At left J. Richard Nalley, secretary; and in background, Dick Bradley, Bradley's Motor & Armature Works, Corpus Christi,, Texas, president Southwestern Chapter.

HELWIG CARBON BRUSHES

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Longer Brush Life
Better Commutation
Less "Down-Time"

HELWIG brushes are precision-built to fit commutator and rings exactly. Ideal as replacement brushes because they're equal in quality and specs to original equipment. Contact HELWIG today!

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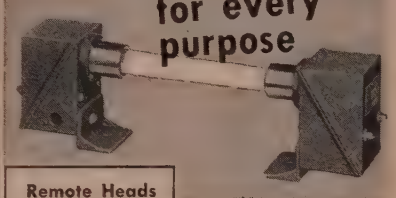
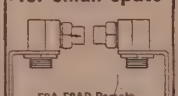
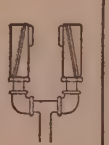
Photoelectric Controls for every purpose



Remote Heads for Small Space



E8A-E8AP Remote heads with special mounting bracket



E1A-E1AP

Compact, rugged—easily positioned remote heads. Available with ¾" diameter straight beam—also fixed focus pin point beam.

Heavy Duty Industrial Construction.

for tension, jam-up, counting, registration, illumination, liquid and material level — sorting, measuring, weighing, inspection, die-protection, smoke detection, packaging, processing, marking.

Wide selection of standard controls and light sources to meet all kinds of uses.

Send for Catalog or tell us what you want to do.

AUTOTRON, INC.
Box 722 DDL Danville, Ill.
Representatives in principal cities

A STUDY OF ESTIMATING COSTS

[FROM PAGE 89]

(cost per contract received) shows how the cost of estimating a definite type of project may vary.

Relative cost percentages for estimating individual projects of different types are shown in Table I. This was developed from a carefully organized and tabulated survey of 1,000 electrical projects made a number of years ago. While the dollar volumes in the first three columns might be considerably greater today, the percentages of base cost for estimating still hold. For the sake of brevity, a number of detailed factors influencing costs are not indicated. However, the limited information divulged is of significance. The table does show the wide range in costs that can be expected and provides pertinent knowledge regarding the effects of the various classes of work and the dollar volume.

Costs range from a minimum of 0.12% (neglecting the miscellaneous listing) for hotels and office buildings to a maximum of 8.20% for small alterations. We expect costs of figuring alterations to be high. Hotels and office buildings have low costs for several reasons. Among them are: 1) volume, 2) typical floors, 3) well engineered plans.

Compared to office buildings and hotels, the cost of factories is high In reality, industrial work is generally low compared to other types. The cost for factories in the table is high because:

1. There were many small projects. Note that the average for factories is $5,254 whereas that for hotels and office buildings is $31,008 and $94,895 respectively.
2. The list does not include the large number of factories let without competition.
3. The survey included the cost of some engineering which is normally charged-off separately.

The values in Table I represent the *cost of the individual estimates* and do not represent the true cost (cost per contract).

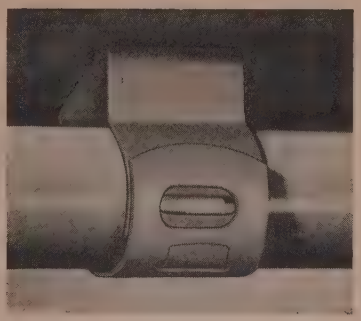
Estimator's Time

From studies similar to those provided by the tables, the contractor can get much help when

(*Continued on page* 300)

Easy To Install! Holds Securely! Introducing

PAINE'S New LIBERTY* CONDUIT CLAMP



Designed For Hanging, And Fastening Of Rigid Or Thin Wall Conduit

Proven in use—a big improvement over other style fastening devices. We urge every electrical contractor, electrician and maintenance man, etc. to try the New Liberty* Clamp . . . prove it to yourself!

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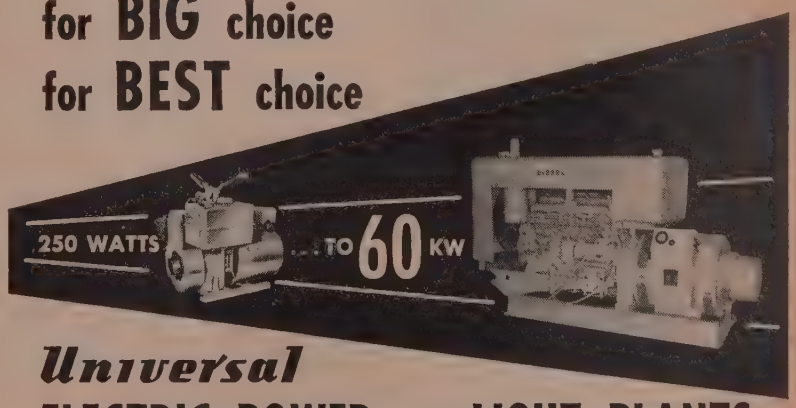

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A STUDY OF ESTIMATING COSTS

(FROM PAGE 299)

evaluating projects to be figured. In turn, careful appraisal will enable him to help his estimators utilize their time to the best advantage.

Some contractors think money is being wasted if their estimators are not constantly kept busy estimating. If there is no promising work in the offing, plans that have little or nothing to offer are brought in to be figured. The estimator grinds day in and day out.

Keeping an estimator busy by having him figure unpromising work is a very foolish and questionable practice because:

1. It takes a useless toll of the estimator's time and energy.

2. It eventually interferes with the estimating of the better projects.

3. The estimator is kept from doing very essential work incidental to good estimating.

An estimator has just so much energy. If it is drained by useless estimating, he cannot do his best work when it is most needed.

Promising work coming into the office must be delayed when useless estimating is going on. This delay necessitates rushing the estimate for the better work. This practice often is responsible for losing contracts and serious mistakes. A contract may be lost because the estimator did not have time to figure out the most economical methods for doing the work. Serious mistakes, due to rushing estimates, is a subject familiar to all of us.

Estimator must have an occasional respite from figuring work. He needs the relaxation from such strenuous activities and has many other essential duties which are incidental to good estimating. He must study the progress of the work under construction; keep his labor data up to date; study men and methods; and carry on many other vital activities.

The Contractor's Studies

While it is not so important that contractors make extensive surveys, they must conduct enough studies on estimating costs to get the "feel" of that phase of their business. And, studies must be complete enough to definitely establish costs per contract received. It must be stated again that values in Fig. 1,

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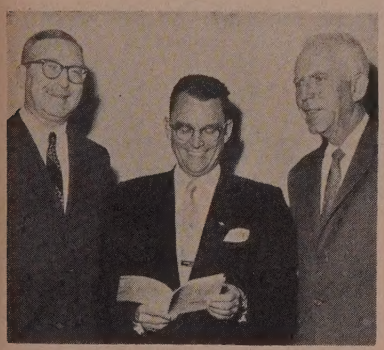
are bare costs for producing estimates and not contractor's costs based on contracts obtained.

Many contractors use 1% for estimating and 3% for combined estimating and engineering. The 1% is too low. For the run of mine business, 2% is more nearly correct. *Electrical Estimating* (McGraw-Hill Book Co.) provides a survey of a $500,000 volume (1949). The study shows 0.80% for missionary work and 1.17% for contracts received, or a total of 1.97% (use 2%). The $500,000 volume includes contracts received without submitting estimated price; hence the 2% instead of a higher figure.

Each contractor must establish costs suited to his type of work and volume. This is important.

Of all the points covered, it seems that the contractor's greatest reward for studying estimating costs is learning to help his estimators use their time to the best advantage. This applies to both actual estimating and work incidental to it.



O. F. BURNETT (right), Kelso-Burnett Electric Co. of Chicago and immediate past-president of NECA, was featured speaker at annual dinner meeting of Contractors Division, Bureau of Home Appliances of San Diego County, Calif. Held concurrently with the January Electrical Equipment Show, the meeting broke all attendance records, 421 persons hearing Burnett speak on "Your Business and the Rest of the World." As a management representative of the U. S. government at the recent Geneva meeting of the Building, Civil Engineering and Public Works Committee of the International Labor Organization, Mr. Burnett spoke knowingly concerning international labor conditions, economic competition and the impact upon our foreign aid program. On the same dinner-meeting program, Dr. E. M. Gherman (left), president, Incandescent Supply Co., Los Angeles, discussed the necessity and values of good communications. Presiding at the meeting was Norman D. Ferguson (center), president of California Electric Works, San Diego.

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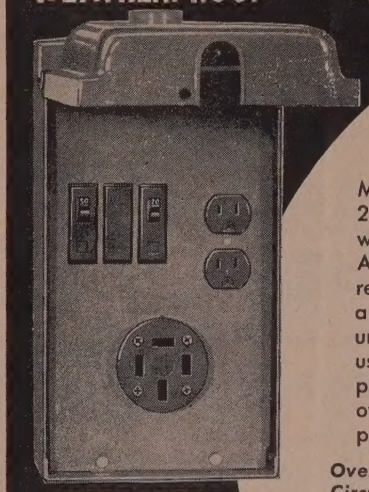

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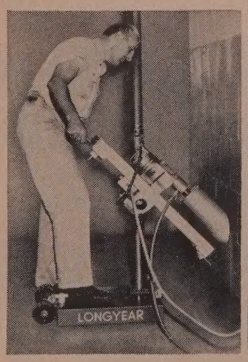

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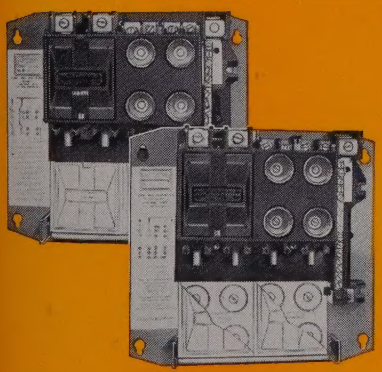

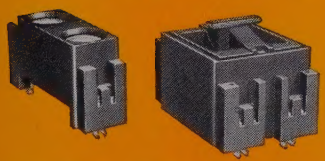

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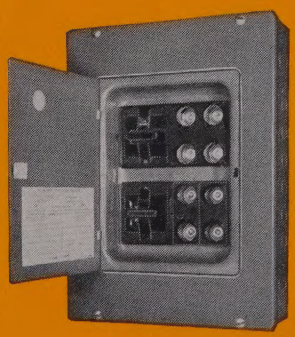

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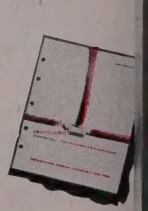

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